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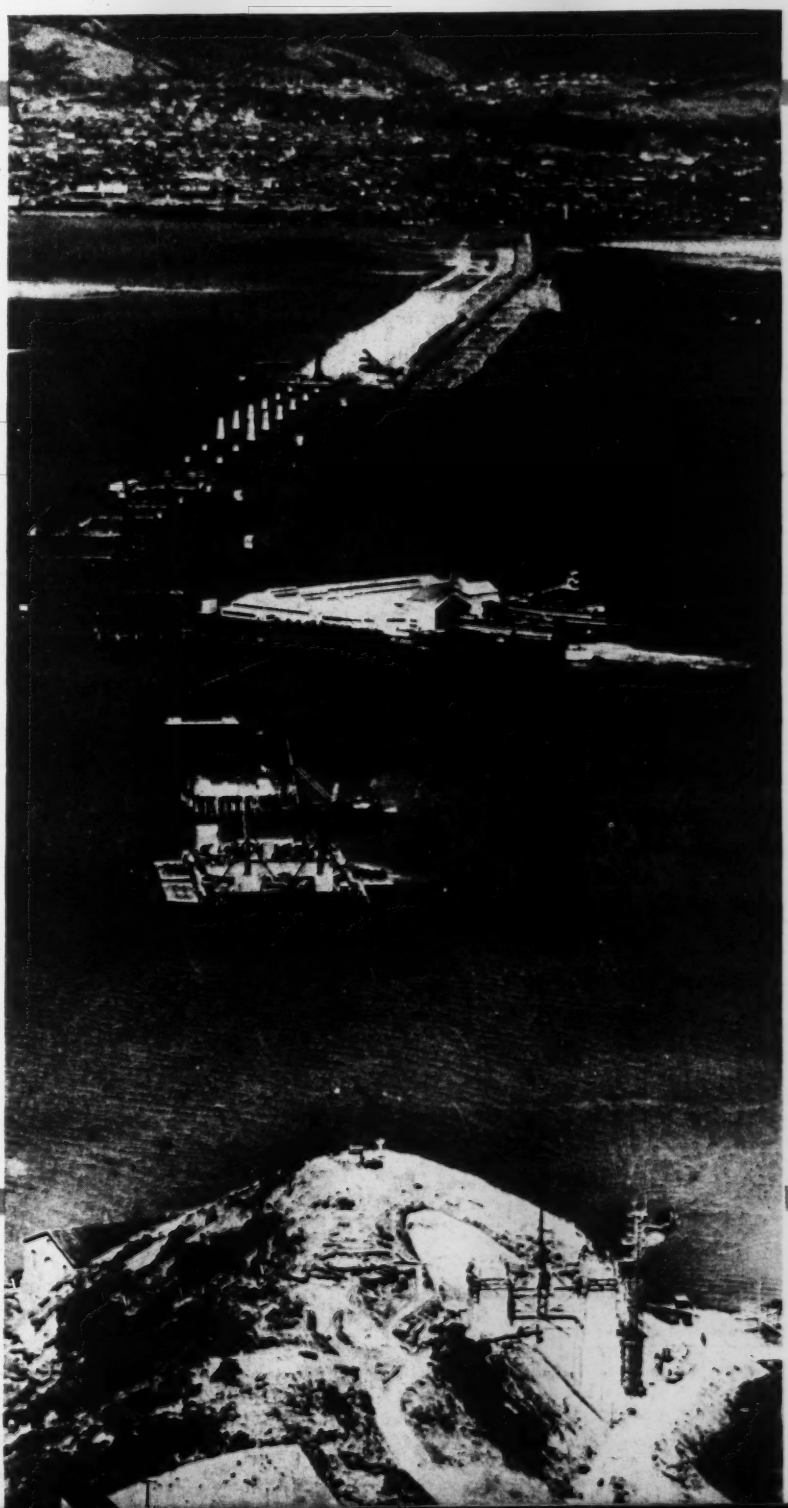


eep Open Caissons for Bay Bridge

Floodflows by lope-Area Method

Fine Clay in Concrete Mixtures

Old Street Rebuilt n Springfield, Mo.

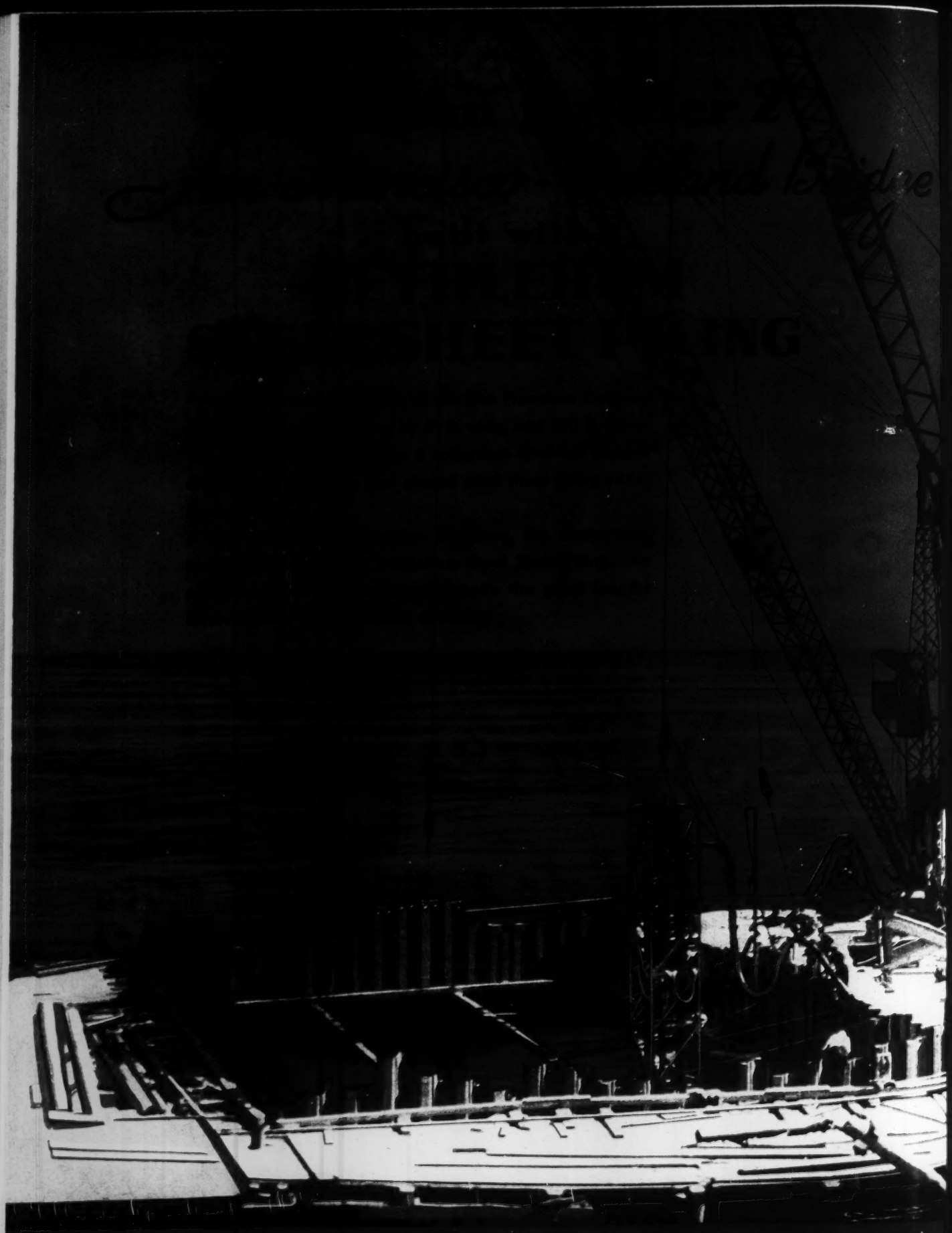
Similitude in Designing Models

Unique Dredge Used in Mexico City

Brick Lining for Irrigation Canal

Bowstring Arch of Three-Hinge Type

Foundation operations on east channel crossing of San Francisco-Oakland Bridge are notable for deep open caisson work. Yerba Buena Island in foreground, Oakland in distance, with ferry house on Key Route Mole near center of the channel



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# *No Time for Petty Plays*

FROM various sections come stories of undue delay in starting work on public works jobs for which contracts have been awarded. With full allowance for the natural impatience of those who count on the construction program to speed business revival, the figures seem to bear out such criticisms.

A survey in June showed that of the PWA allotments, both federal and non-federal, more than 62 per cent had reached the stage of awarded contracts but no more than 15 per cent had actually been expended. During the last two months the rate of expenditure doubtless has been increased but, despite this, there are specific cases in which field work seems to be lagging unduly behind the awards.

It is not easy to assess blame for this condition. Many factors contribute, some doubtless inevitable. But an impression is widespread that much of the delay is unnecessary and deliberate.

One version attributes it to political design. The authorities, so the story runs, are holding back the work until fall when its effects may be expected to influence more heavily the pre-election sentiment of the voters. In other quarters the delay is charged to the influence of certain favored contractors who already have taken enough work to keep them busy for a time and who now would hold up further awards until they can bid them in without increasing their investment in plant and other overhead. Other explanations are advanced but these two are most current and will serve as samples.

This is no attempt to pass judgment on these charges. But whatever the cause, it is evident that delay in this program will weaken the President's recovery program at exactly the worst time and place.

For months we have been told that the crux of recovery is the revival of the capital goods industries. And until private investment has been resumed public works construction must contribute a substantial share of that. Then, too, we have been warned to expect a slackening in the tide of reviving business during the summer months. But here again the public works program was to step into the breach and achieve its peak of employment and purchasing just at that time. On the basis of the program in hand this spring it seemed reasonable enough that affairs should work out just that way.

Obviously then, any undue delay in pushing the work once it is put under contract is a blow at continued recovery. If it results from natural conditions that is unfortunate and those in authority should be working strenuously to relieve those conditions. If, on the other hand, it results from deliberate design that is vicious and someone in very high authority should be calling his subordinates sharply to account for it.

The public works program already has suffered too much from ineptitude and perversion. Its effect has been substantially reduced by failure on the part of those who should know better to push it with consistent vigor. Today there are few valid reasons why field operations, employment and purchasing should not tread on the heels of contract awards.

Whatever may now obstruct such progress should be swept aside. Whether it be the mistaken zeal of political corporals suffering from the delusion that they are helping their chief, the connivance of local authorities with inside contractors or any other reason whatever, someone whose voice will be heard and respected should make clear to all concerned that in the long run political and business fortunes will stand or fall with the consistent progress of general recovery. Any manipulation that prevents the public works program from making its weight felt fully and speedily is detrimental to that recovery.

Any possible advantages to be derived from small-time politics and competitive intrigue are petty and precarious alongside the value to all of handling the big job successfully.

Willard Chevalier

ENGINEERING NEWS-RECORD

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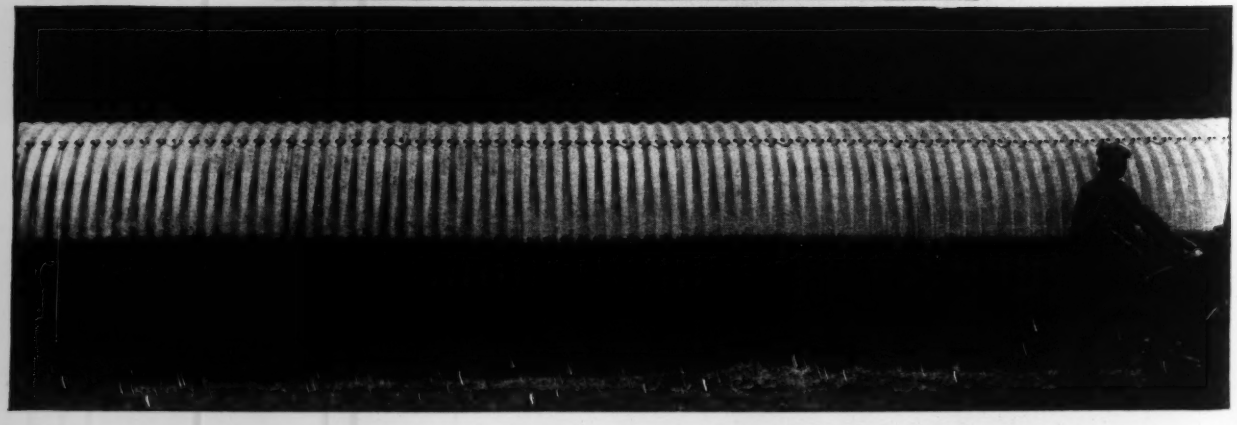

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## In the News:

THE SLOUGHING OFF of the lip of Canada's Horseshoe Falls at Niagara last week has revived talk of the construction of submerged weirs in the upper river to retard erosion, estimated at 3 to 4 ft. per year.

OPENED AUG. 15, 1914, the Panama Canal celebrated its twentieth anniversary last week. Tolls collected on 360,000,000 tons of cargo in 80,000 ships amounted to some $340,000,000 during the two decades.

TREE PLANTING for the great 1,000-mile shelterbelt will be directed from a central office at Lincoln, Neb. Divisional offices will be established in the capital cities of the states concerned.

PASSAMAQUODDY or politics has taken PWA Administrator Ickes to Maine this week. It is said to be his intention to view personally the proposed site of the great tidal power project for which the PWA Board of Review refused to recommend a loan of $47,000,000. The Maine elections are also in the offing.

TEXAS is planning a World's Fair for 1936, a hundred years after the founding of Texas as a republic. One plan proposed to raise money for the celebration is to divert all money in excess of $28,000,000 (present figure) received by the state during that year from the 4-c. gasoline tax.

THE LOCKS at Bonneville Dam, by a recent change in plans, have been increased from 360 to 500 ft. in length and from 15 to 27 ft. in depth, with the present 76-ft. width retained. Thus they will fit into a 30-ft. channel scheme proposed for the Columbia River at some future time.

MISSOURI highway department employees have been asked by the governor to record their brand of politics, according to a recent report.

THE ST. LOUIS COUNTY Sanitary Sewer District has been formed and a bond-issue election approved in connection with the 120 miles of new trunk sewers to be built with a $1,361,000 PWA grant; the proceeds from the bonds are set at $4,517,000.

SLUM CLEARANCE in substantial amount will be accomplished by the Mid-Hudson Vehicular Tunnel project in New York City. The Port Authority has asked bids on demolition of more than five acres of old tenements on the New York approaches.

PWA ALLOTMENTS for sewage works total $184,728,767 (Aug. 1) and for educational buildings $126,755,474 (Aug. 14).

## In This Issue:

SUBAQUEOUS FOUNDATION HISTORY is being made on the San Francisco-Oakland Bridge. On the West Channel crossing a new record depth of about 225 ft. was attained last spring, using unique dome-controlled caissons. This was nearly 50 ft. beyond the previous record. Now, on the East Channel crossing, the record has been increased again by a pier that is founded 240 ft. below water level. The East Channel work, which also includes interesting cofferdams for the shallower piers, is described in this issue by the engineers in charge.

THAT FINE CLAY PARTICLES in sand or stone used for concrete aggregates benefit rather than harm the concrete is indicated by tests at Lehigh University. A conclusion is that many specifications place unwarranted limitations on fines.

MOST of what has been written on the subject of similitude in model design relates to a specific type of model, and therefore is difficult of application generally. R. W. Carlson in this issue discusses similitude requirements in general and shows how only two rules are required to define the necessary and sufficient conditions for both dynamic and static similitude.

FOR CLEANING and enlarging Mexico City's Grand Canal, a special hydraulic dredge has been built, to work in the narrow high-banked channel. An important detail is that the ladder can swing independently of the hull.

AN INSTRUCTIVE pavement-revamping job has recently been completed in Springfield, Mo., where an old 16-ft. concrete pavement, built in 1913, was resurfaced and widened to a modern 40-ft. through-city highway.

A NEW METHOD for calculating flood discharges, in which the inaccuracies due to the assumption of a uniform coefficient of channel roughness are avoided, has been developed by A. H. Davison, hydraulic engineer of Glens Falls, N. Y.

AN EXPERIMENT in lining an irrigation canal in Texas with second-hand building brick has produced useful data as to cost and hydraulic properties. It is the intention to continue the studies.

THE OREGON BRIDGE that was awarded first prize as the most beautiful steel bridge in its price class erected last year is also interesting technically. Of bowstring type, it is a three-hinged arch with the lower-cord ties free from the floor system, to eliminate secondary stresses.

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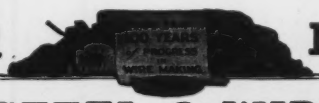
**1831**  **1934**

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ENGINEERING NEWS-RECORD

August 23, 1934

# Deep Open Caissons for Bay Bridge

**Three East Channel piers of San Francisco-Oakland Bridge founded on a deep stratum of stiff clayey-sand, one pier going to a record depth of 240 ft.—Sixteen shallow pile-piers built in sheetpile cofferdams of unusual design**

By C. H. Purcell, Chas. E. Andrew and Glenn B. Woodruff

*Chief Engineer, Bridge Engineer and Engineer of Design, San Francisco-Oakland Bridge*

FIG. 1—THE EAST CROSSING from Yerba Buena Island to Oakland, with caisson piers in foreground and cofferdam piers and approach fill beyond, extending to the shoreline. Key Route Mole and ferry slip at right.

IN THE EAST BAY SECTION of the San Francisco-Oakland Bridge, foundation conditions differ sharply from those in the West Bay, with the result that both the type of superstructure (*ENR*, March 22, 1934, p. 371) and the methods of building the piers differ widely. In the West Bay there will be the double suspension structure, while to the east of Yerba Buena Island there will be a long cantilever followed by a series of simple spans. In the West Bay the piers were constructed by unique dome-controlled caissons, (*ENR*, April 5, 1934, p. 431), while in the East Bay both deep open caissons and unusual sheetpile cofferdams are being used.

Two entirely different foundation methods are necessary in the East Bay because of the extreme variation in loads and soil conditions at different locations. Immediately east of Yerba Island the heavy loads incidental to the long cantilever span had to be carried to great depths, and here three open caisson piers are under construction, the deepest going down to El. —240. Farther east, the loads to be carried were less, by reason of the shorter spans, and the foundation material was firmer so that pile supports built within cofferdams sufficed. Both open caisson sand cofferdams had to be handled with great care, and new problems had to be solved continually as the work progressed.

The requirement for a wide ship channel east of the island and the fact that water depths located this channel close to the island made it necessary to put the west tower pier of the channel span (E-2) practically at the water's edge and the anchor pier (E-1) inshore on the island. The tower pier is being built in open cofferdam carried to rock at El. —45 and sealed by usual underwater methods. The next three piers, E-3, E-4 and E-5, are the deep open-caisson jobs. E-3 carries the heavy load of the east cantilever tower, and E-4 and E-5 also were put down by the caisson method because soil conditions at these locations resembled those in the deep channel more than the firmer formations farther to the east. The remaining eighteen piers are all on pile foundations, the tops of the piles being sealed in concrete. The piers proper are constructed in the dry protected by sheetpiling cofferdams within which the pile-capping seal was placed.

## Controls of design

To provide for vertical forces, the problem consisted mainly of carrying the caissons or piles to a stratum capable of sustaining the superimposed loads without material settlement. To reduce the vertical loads, all piers are of cellular construction, and as a further means of reducing weight, piers E-2 to E-16 extend only 25 to 40 ft. above low water, steel towers extending from the pier tops to the truss shoes. Due to varying loads and temperatures, these towers are subject to heavy bending moments at their bases, and these moments are transferred to the masonry by large anchor bolts extending about 20 ft. into the piers.

The problem of transferring the seismic and wind forces to the foundations was more difficult, the center of gravity of these forces for the cantilever span, being about 210 ft. above low water. A seismic factor of 0.10 $g$ has been used throughout the work. Wind of 30 lb. per sq.ft. on 1½ times the bridge silhouette was assumed, this force acting at right angles to the spans, or at an angle of 45 deg. The latter assumption resulted in very high longitudinal forces. Provision for the stresses arising from the transverse forces could readily be made, since a

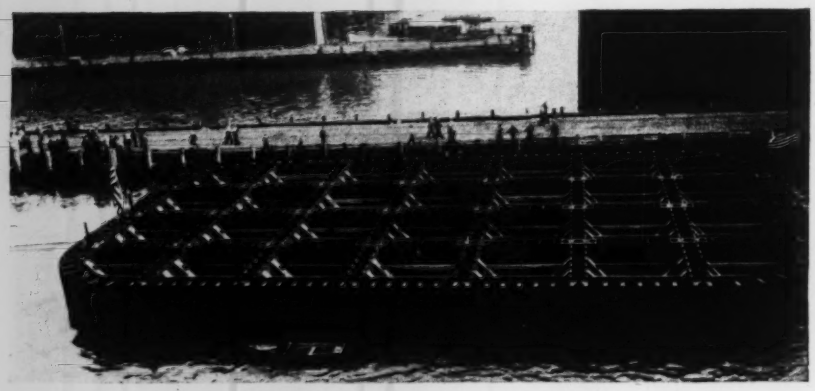


FIG. 2—CUTTING EDGE SECTION of caisson E-3, which was sunk to El. —240 by open dredging. Note 15-ft.-square wells and timber braces for false bottoms.

large dimension at right angles to the bridge was required as a base for the steel towers.

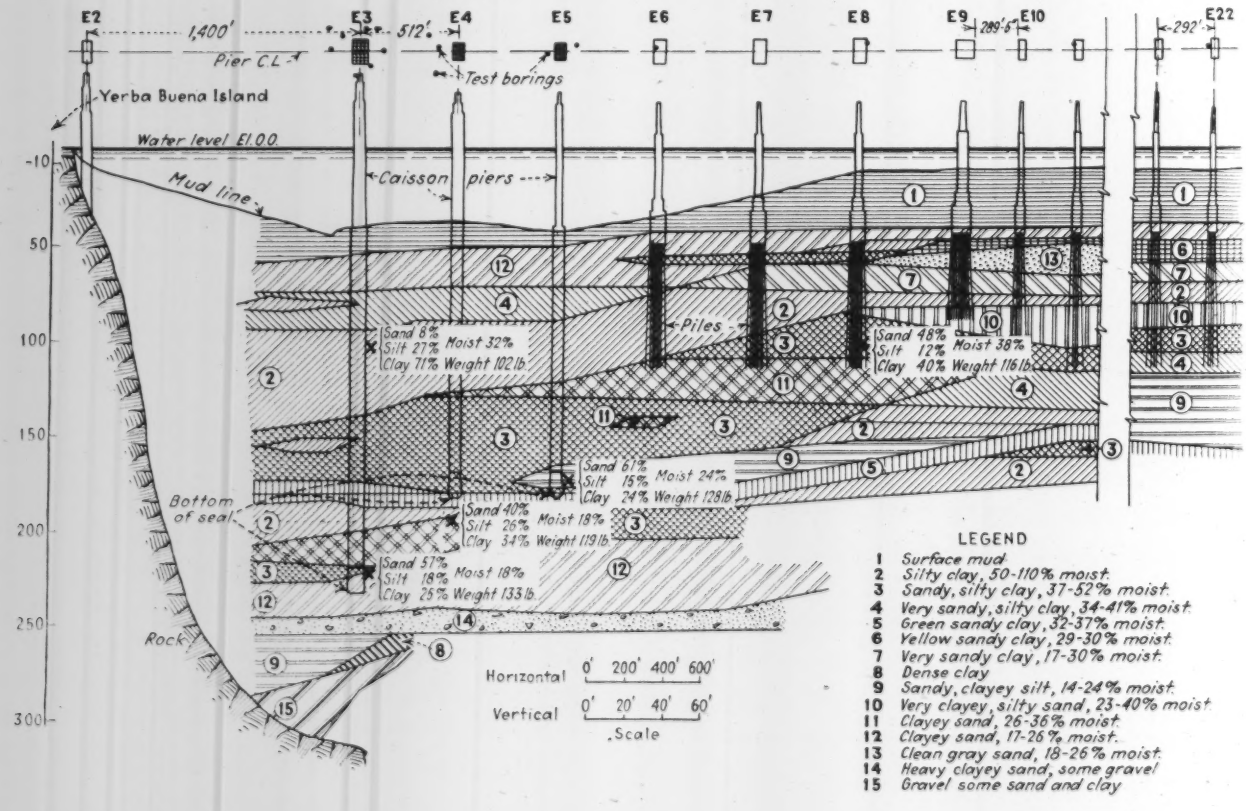
Had it been required to resist the longitudinal forces at each tower, the piers would have been nearly square in plan. To obviate this, a layout (*ENR*, March 22, 1934, p. 371) was adopted, in which piers E-1, E-9 and E-17 act as anchor piers, the intervening piers by reason of the flexibility of the steel bents being subjected only to comparatively small longitudinal forces. Provision for the stresses due to these horizontal forces resulted in all the concrete, except the seals, being heavily reinforced.

For pier E-3 the vertical loads were so great that there was no doubt of the necessity for a deep caisson. The choice was between going to rock at El. —290 or stopping a larger caisson on the sand and gravel formation at El. —240. The strata between the latter elevation and rock were known to consist of stiff clayey sand and gravel, and the depth to rock was so great that an extremely heavy caisson would have been required to overcome skin friction. Because of the depth, also, the cleaning of the bottom would have been more difficult and further, it would have been impracticable for a diver to inspect the bottom prior to sealing. The decision, therefore, was made to found the caisson at the higher elevation, using moderate foundation pressures and placing concrete by tremie in the bottom of the caisson on the comparatively dry clayey sand.

Preliminary designs of piers E-4 and E-5 contemplated using pile foundations. However, the data obtained from borings indicated that the material was not as firm as that farther to the east and that even extremely long piles would not be safe against long-continued settlement of considerable amount. Therefore caissons were adopted for these piers as well as for E-3.

The problem then became that of developing a design that would keep the foundation pressures as low as practicable and at the same time provide sufficient weight in the caissons to overcome skin friction during sinking. After consideration of the nature of the materials to be penetrated, it was concluded that with an efficient jet system the skin friction could be reduced to an average of 800 lb. per sq.ft., or a maximum of 1,600 lb. per sq.ft. at the cutting edge. The existing pressure on the soil at El. —220 approximates 26,000 lb. per sq.ft., so that the assumption is based on a friction coefficient of 0.062. From the results of the tests on the boring samples, a limiting "fatigue" pres-

FIG. 3—FOUNDATION PROFILE along the East Channel section, indicating relative locations of caisson and cofferdam piers and nature of materials. The sampling results indicated illustrate the type of information obtained in the test holes.



sure of 2½ tons per sq.ft. was adopted for the sand and gravel formation under pier E-3 and 1½ tons per sq.ft. for the sandy clay at piers E-4 and E-5. The term "fatigue" is used to express the load in excess of that which the foundation stratum carried before being disturbed by construction.

The only construction fulfilling these foundation and sinking requirements was a cellular caisson with comparatively thin concrete walls. Cylinder construtcion as used in the West Bay crossing (*ENR*, April 5, 1934, p. 431) was too heavy for the purpose. A cellular caisson using timber for the section involved during flotation was not considered satisfactory, as it would have required transferring the loads from the cellular walls to the seals through the timber.

Conditions were favorable for either the sand-island or the false-bottom method, with preliminary estimates indicating a substantial saving in favor of the false-bottom method. The engineers, however, recognized that some contractors would consider the sand-island method less hazardous. In either case the method used would be merely a means of landing the caisson on the bay bottom, and therefore primarily a construction problem. Furthermore, it was probable that the contractor would prefer to use details with which he was familiar rather than those proposed by the bridge designers. In either method satisfactory results would depend on the development of a great many details, for which the engineers believed the contractor should be held responsible.

The contract drawings therefore indicated only the essential features of the permanent construction. The limits set for minimum weights during sinking and maximum foundation pressures led to the following designs:

| | Caisson E-3 | Caissons E-4 and E-5 |
|---|---|---|
| Plan dimensions | 80' 1" x 134' 6" | 60' 1" x 90' 5" |
| Dredging wells | (28) 15' 5" x 15' 7½" | (15) 13' 7" x 14' 10" |
| Outside walls (thickness) | 4' 0" | 4' 0" |
| Inside walls (thickness) | 3' 0" | 3' 6" |
| Buoyant load at base (tons) | (El.-235) 73,200 | (El.-180) 30,000 |
| Intensity of vertical pressure, live plus dead (tons) | 7.0 | 5.6 |
| Vertical pressure including earthquake (tons) | 26.0 | 25.0 |
| Present intensity of pressure, buoyant (tons) | 5.0 | 4.0 |

## False bottoms and sinking

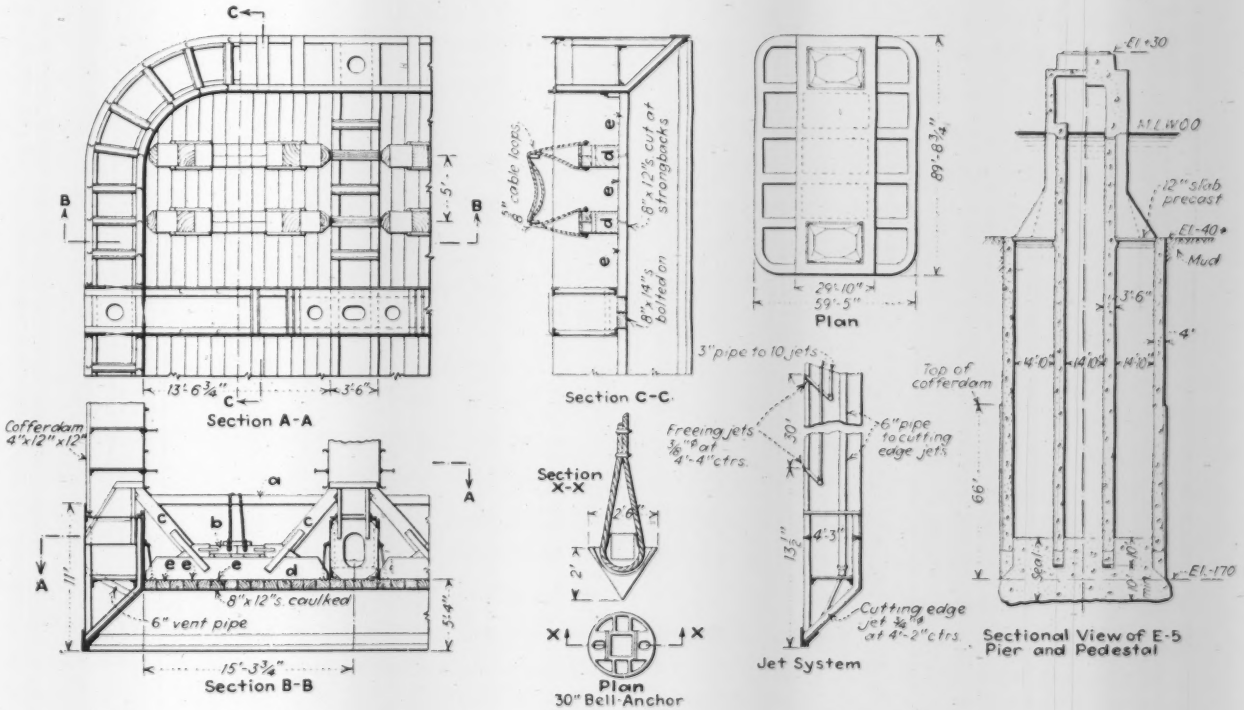
After the award, the contractor elected to use the false-bottom method. Details of the cutting edges and false bottoms were developed jointly by the contractor and the design division of the project. The cutting edges (Fig. 4) consist of comparatively light steel sections, assembled in the shop. After riveting or welding, the members for E-4 and E-5 were assembled on a marine railway into the completed cutting edge, the joints between the members completed, the false bottoms placed and the caisson was then floated. Pier E-3 caisson was too large for the marine railway. It was assembled on shipways and launched.

The success of the false-bottom method of starting a caisson for a pier foundation depends, to a large extent, on the ease with which the false bottoms can be removed; also, the removal must be controlled to regulate the initial sinking of the caisson. The overturning of the east caisson of the Mid-Hudson Bridge at Poughkeepsie five years ago was an indirect result of difficulty in removing the false bottom.

In the present case, the bracing was so arranged that it could be removed by a pull from the derricks. Where sliding was to occur during the withdrawal operation, the surfaces were sheeted with zinc. In the assembly of the false bottom a steel cable was attached successively to the members lettered *a*, *b*, *c*, *d* and *e* in Fig. 4. Enough slack was allowed between any two successive points of attachment so that when the line was pulled upward each member could break out and come free before the pull came on the next member. This plan succeeded remarkably well, as shown in Fig. 6, in which the successive members can be seen dangling in air after being pulled out. At caisson E-3, 24 of the 28 false bottoms were removed in six hours, the other four purposely being left for a subsequent operation.

The upper strata of the alluvium, especially at piers E-3 and E-4, were very soft. Caisson E-3 settled 20 ft. below the original mud surface before the removal of the false bottoms, and the mud

FIG. 4—CAISSON DETAILS, showing system of blocking for removing false bottoms from dredging wells and the general features of pier design.



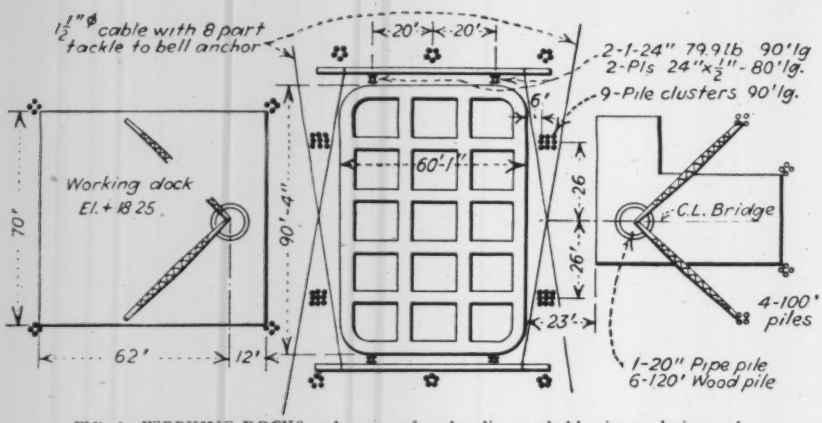



FIG. 5—WORKING DOCKS and system of anchor lines to hold caissons during early stages of sinking.

outside boiled up 10 ft. during this period. After this settlement the pressure under the false bottoms was only 700 lb. per sq.ft. in excess of that outside the caisson.

The success of any caisson operation is due to the care and skill of the contractor during the several operations. It is possible in the design to make provision for facilitating these operations and reducing their inherent hazards. When a false-bottom caisson reaches the mud, a sliding tendency often develops. To reduce this hazard, the false bottoms were placed 4½ ft. above the cutting edge. In some instances the removal of the false bottoms has been very difficult. In this case, as already outlined, the bracing was so arranged that it could be removed by a pull from the derricks.

FIG. 6—FALSE-BOTTOM REMOVAL from dredging well by derrick. The derrick at the left did the pulling, the grab bucket at right merely aided in giving clearance during lifting. Note that sections of floor are actually attached to the brace timbers to insure their removal.

At pier E-3 the mud under the northwest corner was considerably softer than the average, so that a list of 3 ft. in the diagonal direction developed, and the caisson took a skew of more than 2 ft. The contractor was able to overcome both these difficulties by the same operation. Excavated material was piled outside the caisson at the northwest corner. This surcharge prevented excessive settlement at this corner and also furnished a horizontal force that restored the caisson to its true position.

Dredging on the outside of the caisson at the south end increased the settlemen at that end and completed the plumbing procedure.

The false bottoms were removed in such order as to keep the caisson level at all times. The softer material at the northwest corner made it necessary to depart to some extent from symmetry, the four bottoms left for later removal being at the northwest corner. During the removal of the 24 bottoms the caisson sank only 8 ft.

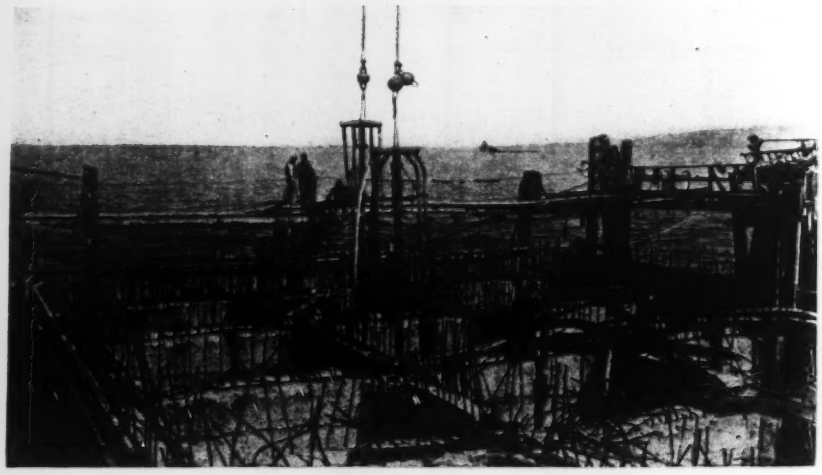
The 3⅝-in. timber cofferdam, extending 66 ft. above the cutting edge, was used only during the flotation period. Steel forms, made up in panels, were used above the cofferdam and for all interior walls above the cutting-edge section. At caisson E-5 considerable leakage developed at the junction of the steel cutting edge with the timber. This was corrected in the later caissons by a canvas strip mopped over the joint with hot asphalt.

## Jetting and sealing

The contractor installed a very complete system of jets for relieving or freeing the cutting edge, so arranged that they might be used at any desired part of it. In addition to the jets, the contractor coated all surfaces exposed to skin friction with varnish, to serve as a lubricant. At E-4 and E-5 the jets were not needed and were not used except that the cutting-edge jets were used while cleaning the foundation preparatory to placing the seal.

The system of anchoring the caissons to hold them in place during sinking was developed by the contractor. It proved both efficient and economical. It is in notable contrast with the much heavier system of concrete anchors which the contractors on the West Bay crossing considered necessary. The method used on the East Bay contract was to drive a steel column a few feet outside each corner of the rectangular space to be occupied by the caisson. A horizontal strut, fastened to the tops of each pair of these columns (Fig. 5) was the terminus for two of the anchor lines, there being four anchor lines in all. From an eight-part tackle attaching it to the strut, each anchor line extended to cast-iron bell anchors (Fig. 4), which were put down in the mud with the aid of the piledriver. That is, the bell anchors, with steel cable attached, were fastened to the bottom of a wood pile, and the pile then was driven about 25 ft. into the mud some 500 ft.

FIG. 7—JETTING OPERATIONS in the dredging wells prior to placing tremie-concrete seal. Each jet header was served by four lines of fire hose, which were handled more easily than pipe.



from the caisson. After driving, the pile was broken off at the mud line and its upper portion removed. By taking up on the anchor-line tackle the required amount of stress was readily put in this line without danger of dragging the anchor. Timber blocking between the steel columns and the caissons, with the aid of these anchor lines, held each caisson in position accurately while it was being sunk.

During sinking it proved possible to control the horizontal position within very narrow limits by listing the caisson as it proceeded downward. Sufficient list was obtained by carrying the dredging, which was done with a clamshell, slightly deeper on one side than on the other. The final cutting edge of pier E-3 is within 8 in., E-4 within 1 in. and E-5 within 3 in. of design locations.

The rates of caisson sinking were:

| Caisson | Feet Per Calendar Day |
|---|---|
| E-3 | 1.83 |
| E-4 | 1.08 |
| E-5 | 1.13 |

All hoisting and dredging operations are performed from fixed working platforms. Two stiff-leg derricks each were used at piers E-4 and E-5, and upon completion of these piers the four derricks were moved to platforms at the site of pier E-3.

The sealing of the caissons was done in three operations. When the cutting edge had reached the desired depth, the excavation for three wells of piers E-4 and E-5 and twelve wells of E-3 along the bridge center line was carried 15 ft. below the cutting edge. All cutting edges were cleaned by jetting, and excavation was carried down vertically from the side cutting edges. Slime resulting from the jetting was removed by pumps. The bottom was inspected by diver before placing the seal, which was deposited by 2-cu.yd. bottom-dump buckets. The diver employed by the state for this work assembled decompression equipment especially built and mounted on a barge, which was towed to the point where diving was done.

The first part of the seal was placed in the central wells only, thus providing a base that would allow final cleanout by jets—including some undermining of the cutting edge—without causing any further sinking of the caisson. Then sealing operations proceeded at the ends.

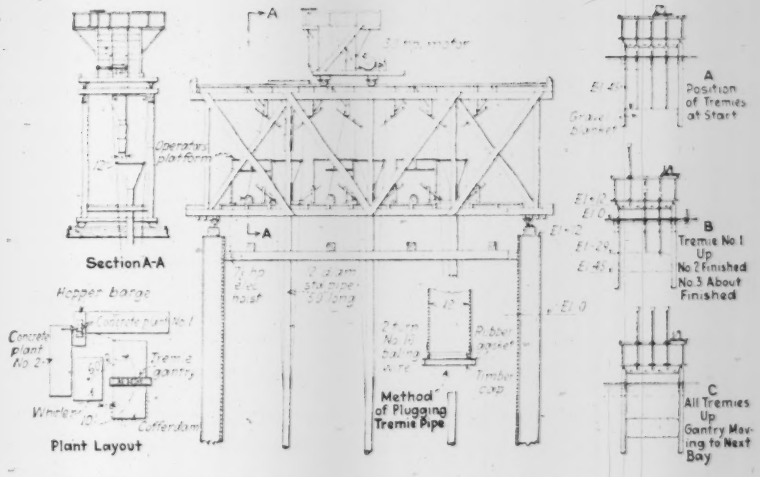
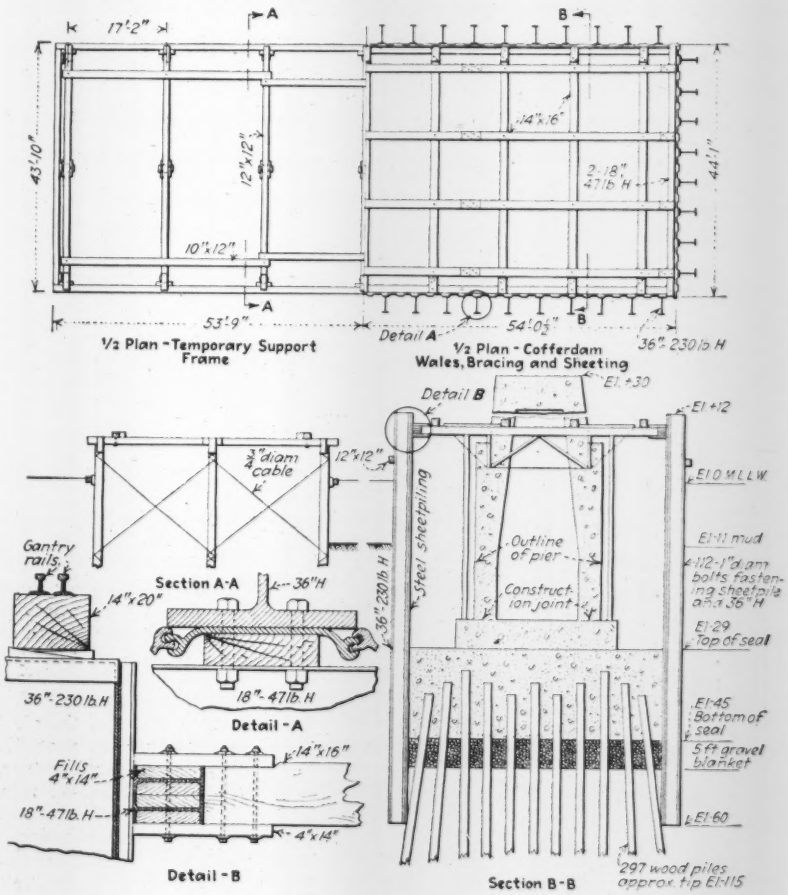



FIG. 9—TREMIE GANTRY, arranged for rapid concrete placing and accurate control of pipe position, was served by floating concreting equipment.

FIG. 8—PILE PIER CONSTRUCTION FEATURES with details of steel sheet cofferdams, using heavy H-beams as master piles to reduce interior timber bracing.




## Cofferdam piers

The seventeen piers placed on pile foundations will carry the superstructure from the end of the cantilever anchor arm at E-5 to the long fill extending out from the East Bay shore. In these pile piers it was considered essential to get satisfactory stability against lateral loads. In fact, the foundation strata have sufficient supporting value to carry the design load of 2 tons per sq.ft., the piles being used mainly to improve the resistance to seismic forces, although proportioned to carry the entire vertical load at 35 tons per pile. To keep the loads to a minimum, the piers above the seal are made cellular. The timber piles are spaced 4 ft. on centers.

The steel sheetpile cofferdams are of a new type of construction that greatly reduces cross-bracing and eliminates the necessity of cutting out and reshoring the bracing during pier construction. There is also much less leakage than with the usual type of sheetpile coffer-

dam. To every fourth pile is bolted a 36-in., 230-lb. I-beam, the combination making a master pile at 5-ft. intervals. The only cross-bracing is above high water, the master piles having sufficient strength as a beam, from the top of the seal to the cross-bracing, to sustain the water pressure. The sheeting between the master piles acts as a horizontal suspension span, producing a tension which tightens the interlock so that the average leakage into a cofferdam has been only 500 g.p.m. The sheeting is 72 ft. long, extending 12 ft. below the bottom of the seal. The top of the master piles also supports the rails on which the piledriver and concrete gantries are supported.

At the start of construction on a pile pier, the site is first dredged to El. —25, and the cofferdam bracing is supported on falsework piles. To this falsework is bolted a steel guide-frame carrying vertical guides for three of the master piles. Great care is taken to get the guide frame plumb and to keep it so. Then the master piles are accurately placed, and the sheetpiling between them goes into place smoothly and rapidly. When the piling on the first guide frame is down, a duplicate frame is placed alongside by sliding its edge down a vertical groove in the first frame provided for that purpose, thus tying guides for the second group of master piles to the first. Later the first guide frame is moved to the far side of the second, and so on. Each side of the cofferdam is built separately, final closure being made by a V-joint of two pieces of steel sheetpiling driven at each corner. Enough sheetpiling was provided by the contractor to serve four cofferdams, this being about 3,000 tons, of which 2,000 tons is in master piles and the remainder in the sheetpiling.

The excavation is then completed, the inside faces of the cofferdam washed with a jet, and the foundation piles driven.

Upon completion of the driving, the bottom is cleaned by pumping. An inspection of the bottom is then made by diver, any areas not thoroughly cleaned are jetted and pumped, and all broomed pileheads are cut off. Next, a gravel blanket is dumped in by grab buckets over the dredged excavation and around the pileheads to provide a clean bed for the concrete. The surface of this blanket is kept as uniform as possible, and upon it concrete is placed by tremies, as described later. A week after placing the seal, the cofferdam is dewatered, the surface of the seal is cleaned and the remainder of the pier constructed in the dry.

Very hard driving has been necessary to get the cofferdams down to grade, and removal of the piling, particularly of the master piles, has proved difficult. The master piles are first driven down about 3 in. to break the bond between the piles and the concrete seal. The piles are then jetted, using a five-nozzle jet fastened to a frame which fits around the 36-in. beam, so that the force of the jets is accurately applied. The piles are then removed by the pulling barge, and an auxiliary set of falls permits the use of a steam pile-extractor when the 150-ton pull is applied.

## Concrete

Concrete is supplied to the work by the same barges that supply the West Bay crossing (*ENR*, April 5, 1934, p. 431), and is delivered to a receiving barge from which it is handled by derrick to hoppers on the piers or on the concrete gantries. For concrete placed within forms, the concrete drops into place through elephant-trunks with a maximum drop of about 24 ft. All concrete is worked within the forms with a 3-in. internal-type pneumatic vibrator. The classes of concrete used on the work are:

| Class | Cement Sacks per Cu. Yd. | W/C Ratio | Slump, In. Approx. | 28-Day Strength Lb. per Sq. In. |
|---|---|---|---|---|
| A-structural | 6 | 0.75 | 1½ | 4436 |
| A-under water | 6 | 0.85 | 3 | 3657 |
| B | 5 | 0.85 | 1½ | 3367 |

Class A structural concrete is used in the thin cellular walls of the pile piers, and Class B for other concrete placed in the dry.

FIG. 10—PLACING CONCRETE BY BUCKETS from floating mixing plant to hopper over the tremie pipes supported by timber gantry.

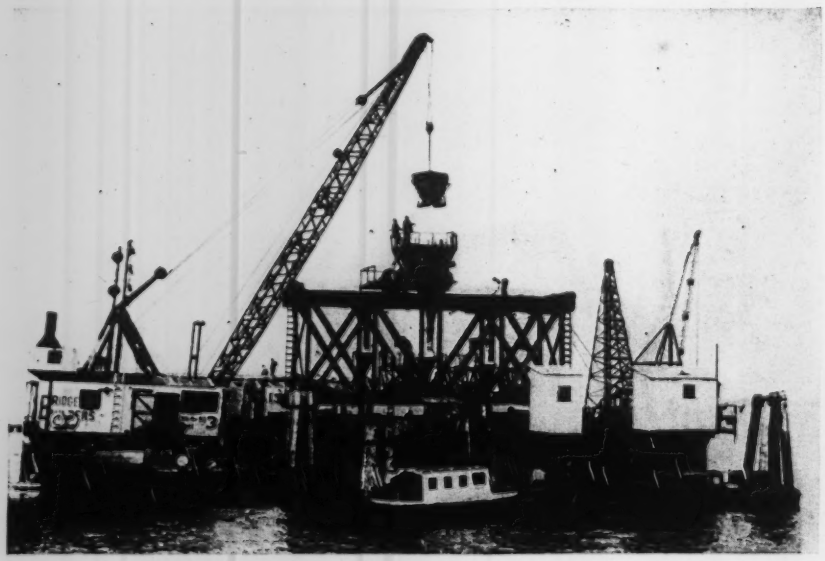


FIG. 11—SURFACE of tremie seal after unwatering cofferdam. Work is starting on placing forms for pier footings.

## Contractor's equipment

A piledriver designed especially for this work is mounted on a turntable, which in turn is supported by two transfer tables, providing horizontal movement in either direction. The leads are telescopic for about 40 ft. of their length and also are hinged so they can be tilted backward for driving the batter piles. Only this one driver is used for all of the seventeen pile piers, but there have been no breakdowns that have held up the work. However, changes in the hammer itself were required. The first hammer had a rectangular head, and the corners occasionally "hung up" on obstructions, such as the tops of adjoining piles. The contractor had new heads made with chamfered corners, which eliminated this difficulty. Piles are driven to a penetration of El. —115, with a limit of 100 blows for the last foot. The average rate of driving is 1½ to 2½ piles per hour according to the strata encountered and amount of jetting necessary. Jetting was necessary in some of the piers to penetrate the sand stratum at El. —65. The driver, of double-acting type, weighs 10,850 lb., has a 3,000-lb. ram, and is equipped for underwater driving.

The tremie gantry, also developed expressly for this job, is designed to give an even distribution of concrete over the area to be sealed. As shown in

Fig. 9, tremie pipes are served successively from a hopper on a transverse truck above them; the hopper, in turn, is filled with concrete by a floating derrick. Pouring begins at one end of the cofferdam, and concrete is brought up to specified level in each bay before the tremies are raised to pass over the bracing and move to the next bay. When placed in this way, the concrete in the cofferdam is found to take a slope of about 3 to 1. The arrangement of tremies was found to be satisfactory; it permits the pipes to be placed accurately and the elevation controlled quickly, to insure against losing the charge. In no case has there been any leakage through any of the seals.

### Equipment Items

Four stationary stiff-leg derricks are used at piers E-3, E-4 and E-5, each equipped with 150-hp. motor, 3-drum hoists, 100-ft. booms, capacity of 21 tons at 60-ft. radius or 13 tons at 90-ft. radius.

Two whirler cranes on 40x64-ft. barges, with 65-hp. boiler, 3-drum hoists, 85-ft. boom, capacity 20 tons at 30-ft. radius or 7 tons at 75-ft. radius.

Two stiff-leg floating derricks, with 60-hp. boiler, 3-drum hoist, 100-ft. boom, capacity 10 tons at 60-ft. radius, 6 tons at 90-ft. radius. Barges 36x72 ft. and 40x80 ft.

One pile-pulling barge 96x34 ft. with A frame 100 ft. high, two 8-sheave blocks, 24- and 30-in. diameter, 16-part plow-steel line, 50-hp. engine, 4-drum hoist, 150-ton capacity.

### Schedule

Bids (see tabulation in *ENR*, Mar. 23, 1933, p. 393) for this work were received on March 7, 1933, and the contract was executed on May 16. After the award of the contract more than four months were required to assemble plant and equipment; the first cofferdam was not completed until Sept. 26, and the first caisson did not reach the site until Aug. 31. The contract schedule and the progress which the contractor estimates are given in the accompanying table.

COMPLETION SCHEDULE

| Pier No. | Contract Schedule | Contractor's Estimate |
|---|---|---|
| E-2 | Sept. 15, 1935 | Nov. 1, 1934 |
| E-3 | Sept. 15, 1935 | Nov. 1, 1934 |
| E-4 | July 16, 1935 | *July 7, 1934 |
| E-5 | June 1, 1935 | *July 25, 1934 |
| E-6 | Feb. 26, 1935 | Nov. 1, 1934 |
| E-7 | Mar. 16, 1935 | Oct. 15, 1935 |
| E-8 | Feb. 16, 1935 | Oct. 1, 1934 |
| E-9 | Jan. 16, 1935 | Sept. 15, 1934 |
| E-10 | Dec. 16, 1934 | Sept. 1, 1934 |
| E-11 | Nov. 16, 1934 | *July 6, 1934 |
| E-12 | Oct. 16, 1934 | *July 23, 1934 |
| E-13 | Sept. 16, 1934 | *July 9, 1934 |
| E-14 | Aug. 16, 1934 | *June 14, 1934 |
| E-15 | July 16, 1934 | *May 28, 1934 |
| E-16 | June 16, 1934 | *May 10, 1934 |
| E-17 | May 16, 1934 | *Apr. 24, 1934 |
| E-18 | Apr. 16, 1934 | *Apr. 21, 1934 |
| E-19 | Mar. 16, 1934 | *Mar. 12, 1934 |
| E-20 | Mar. 15, 1934 | *Mar. 8, 1934 |
| E-21 | Mar. 16, 1934 | *Mar. 9, 1934 |
| E-22 | Mar. 16, 1934 | *Mar. 3, 1934 |

*Actual completion dates.

Although contract dates, as noted in the table below, do not call for final completion until September of next year, progress of the work up to date has been such that it seems probable that all piers on this contract will be completed this fall.

The principal quantities of materials in the 21 piers east of Yerba Buena Island are:

| | |
|---|---|
| Structural-steel cutting edge | 620 tons |
| Concrete | 175,000 cu. yd. |
| Reinforcing steel | 3,500 tons |
| Timber piles (permanent) | 600,000 lin.-ft. |
| Anchorage steelwork | 160 tons |

The contract for this work is held by Bridge Builders, Inc. H. J. Kaiser is president, E. H. Connor managing engineer, and C. B. Jansen superintendent. V. A. Endersby is resident engineer for the state. The complete personnel of the California Toll Bridge Authority appeared in *ENR*, March 22, 1934, p. 377.

# Tests Indicate Effect of Fine Clay in Concrete

**Test results support claim that requirements which limit fines severely are unnecessary and, when admixtures are permitted, are illogical**

By Inge Lyse
*Research Associate Professor of Engineering Materials, Lehigh University, Bethlehem, Pa.*

THE QUESTION of how much very fine material should be permitted in concrete sand is of considerable economic interest. Many official specifications reduce the amount of fines passing the No. 100 sieve to only 5 per cent. Often the sand is washed to remove a part of the excess amount of fines, and later admixtures are added in order to supply sufficient very fine material for the production of a workable concrete mix. This procedure immediately raises the question: Why remove the fines from the sand in the first place?

An investigation that contributed some information on this subject has been carried out at the Fritz Engineering Laboratory of Lehigh University. This investigation, which was conducted by G. W. Parkinson, former research fellow in civil engineering, under the direction of W. A. Slater, late research professor of engineering materials, included the study of the substitution of clay for a portion of the cement, the sand and the total aggregates in the concrete mixture. The effect of the clay was noted on the placeability of the mix, the compressive strength, the permeability and the durability of the concrete. While the results of this investigation apply to clay only, they may be of considerable significance as indications of the effect of any finely powdered inert material on the properties of concrete.

The program for the investigation is given in the accompanying table. The amount of clay used in each mix has been given in percentage of the cement content, by weight, in all groups. Actually groups B and D had 10 per cent by volume of the cement, groups E and F had 7½ per cent of the sand, and groups G to L had 3 per cent of the total aggregates replaced by clay.

The placeability of the concrete was found to be somewhat improved by the clay content. Segregation was reduced materially, and the mix appeared considerably richer when clay was used.

PROGRAM OF TESTS

| Group | Cement Content Sacks/Cu.Yd. | Cement-Water Ratio by Wt. | Clay Content Per Cent Cement by Wt. | Sand-Gravel Ratio | Test Made |
|---|---|---|---|---|---|
| A | 5.0 | 1.64 | 0 | 34-66 | Consistency |
| B | 4.5 | 1.46 | 10½ | 34-66 | Strength |
| C | 6.0 | 2.00 | 0 | 34-66 | Permeability |
| D | 5.4 | 1.71 | 10½ | 34-66 | Durability |
| E | 5.0 | 1.55 | 17½ | 34-66* | |
| F | 6.0 | 1.78 | 14 | 34-66* | |
| G | 5.4 | 1.40 | 0 | 40-60 | Placeability |
| H | 5.5 | 1.40 | 17 | 40-60 | Strength |
| I | 5.4 | 1.40 | 0 | 35-65 | Permeability |
| J | 5.1 | 1.40 | 19 | 35-65 | |
| K | 5.7 | 1.40 | 0 | 30-70 | |
| L | 5.3 | 1.40 | 18 | 30-70 | |

*Clay considered part of sand in this ratio.

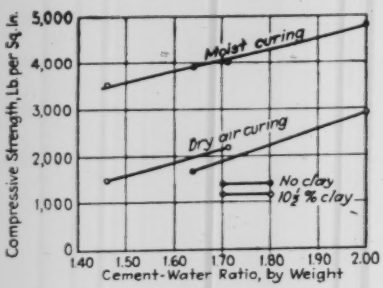



FIG. 1—EFFECT of clay on strength of concrete having different cement-water ratios.

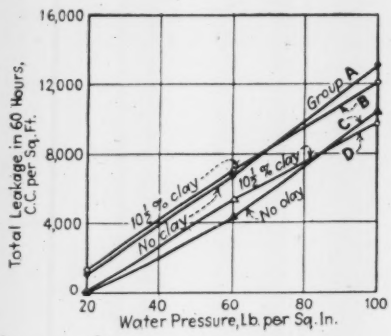



FIG. 2—CONCRETE PERMEABILITY as affected by clay in the sand.

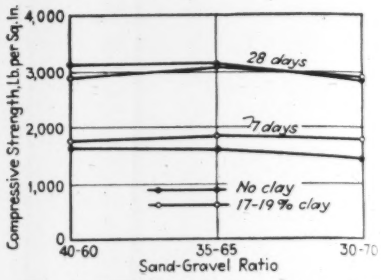



FIG. 4—EFFECT of clay on strength of concrete having different sand-gravel ratios.

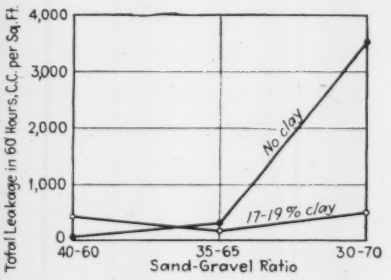



FIG. 3—PERMEABILITY of concrete having different sand-gravel ratios as affected by clay content of sand.

The results of the compressive tests are presented in Figs. 1 and 4. In Fig. 1 the average strength for all ages has been plotted against the cement-water ratio of the cementing paste. Evidently the clay had some beneficial effect upon the specimens that were cured in the dry air of the laboratory but had no effect upon the strength of the moist-cured specimens. Fig. 4 shows that a clay content as great as 17 to 19 per cent of the cement had a beneficial effect upon the results of the 7-day tests, while the results of the 28-day tests showed little or no effect for concrete mixes of a given cement-water ratio. The result also showed that the clay gave a smoother mix and had a slightly greater beneficial effect upon the strength of concrete having an under-sanded mix than on a concrete with a sufficient sand content.

The effect of the clay content on the permeability of the concrete is illustrated in Figs. 2 and 3. The permeability tests were made in the same type of testing units as used by the Portland Cement Association. Fig. 2 gives the leakage of specimens of groups A to D at ages of 60, 180 and 360 days. The water pressures used at these ages were 20, 60 and 100 lb. per sq.in. respectively. Since the specimens were cured in dry air, the effect of the age was probably very small. The difference in leakage may therefore be considered caused by the variation in the water pressure used. Although groups B and D contained 10 per cent less cement (and consequently lower cement-water ratios) than did their companion groups A and C, the leakage of group B was nearly equal to that of group A, and the leakage of group D was nearly equal to that of group C. The clay, therefore, had a beneficial effect upon the permeability of this concrete.

Further evidence of the effect of the clay on the permeability is given in Fig. 3 for concrete of a given cement-water ratio. For the 40-60 sand-gravel ratio the clay seems to have increased the leakage slightly. However, for the 35-65 ratio the leakage is less for the concrete containing clay than for that without clay, and for the 30-70 ratio the beneficial effect of the clay is very marked.

These results indicate that materials containing clay to as much as 3 per cent of the amount of total aggregates may be safely used in concrete construction. A support to this indication is found in the durability tests. Fig. 5 shows some of the concrete cylinders that had been subjected to more than 100 cycles of freezing and thawing, and illustrates the importance of moist curing as well as the effect of the clay content. Although groups B and D had 10 per cent lower cement content than their companion groups A and C, the appearance of the former indicates approximately the same degree of disintegration as the latter.

Thus all the different tests included in this investigation point to the important fact that concrete aggregates containing a considerable amount of clay are in no way inferior to aggregates from which the clay has been eliminated by washing. Other finely powdered inert materials very likely would give similar results. It seems, therefore, that present specifications may place unwarranted limitations on the amount of very fine material in the aggregates. These limitations appear especially uncalled for in cases where fine powder in the form of commercial admixtures is reintroduced to the washed aggregates.

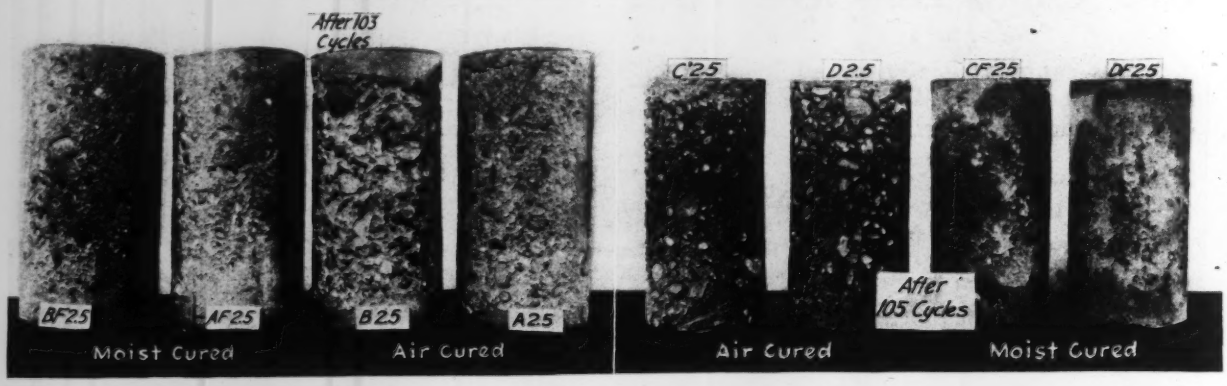



FIG. 5—DURABILITY OF CONCRETE with and without clay, as measured by freezing and thawing test. Groups B and D contained 10 per cent clay, groups A and C none.

# Similitude Requirements in Model Design

**Meeting the requirements of two simple but exacting rules comprises the basis of model design in the fields of both structures and hydraulics**

By Roy W. Carlson
*Research Engineer, University of California, Berkeley, Calif.*

AT THE RECENT model study conference (*ENR*, June 28, 1934, p. 843) held in conjunction with the annual meeting of the Society for the Promotion of Engineering Education at Cornell University, Ithaca, N. Y., the first paper on the program was devoted to a general consideration of the laws of similitude upon which all model study work is based. No previous discussion on this important subject that has come to our attention has so well combined elementary explanation with technical exactitude and practicality. The paper by Mr. Carlson, therefore, is published here in full as a significant contribution to the literature of a field of engineering study that is under rapid development. The paper is also supplemented by a discussion given at the meeting by Prof. K. C. Reynolds of the Massachusetts Institute of Technology, which supplies additional information relating specifically to hydraulic model studies. —EDITOR.

IN ITS broadest sense, similitude exists when there is some systematic relation between the behavior of a model and that of its prototype, but for most engineering purposes it may be assumed that similitude exists only when there is direct proportionality between homologous forces, deflections, strains, times, etc. Numerous papers have been written on the subject, usually, however, with a particular type of model in mind. Here an attempt will be made to show that for the entire field of models only two rules are required to define the necessary and sufficient conditions for dynamic and static similitude.

These two rules are as follows:

RULE 1.—*The model shall be geometrically similar to its prototype, except as to dimensions which do not affect the behavior of the model.*

RULE 2.—*The force scale-reduction factor shall be the same for forces arising from each of the various influences.*

Not only do these rules insure strict similarity, but they also allow free choice to be made of a certain number of scale-reduction factors (such as lengths, times, elastic moduli, etc.) and they provide a basis for computing the remainder.

Rule 1 merely signifies that the ideal model is proportioned exactly like the prototype, all dimensions in the prototype (including thickness of individual members) being reduced by exactly the same factor to obtain the model. In other words, the first rule fixes the relative dimensions of the model.

The second rule fixes the properties of the material of which the model can be built and also interprets the measurements on the model in terms of the prototype. It is apparent that since all influences must be reduced in the same proportion, the more influences there are the more difficult it becomes to fulfill exactly the requirements of Rule 2. It will be shown later that in many cases the requirements of Rule 2 cannot be exactly met in practice and, as alternatives, the designer can either sacrifice exactness or resort to an indirect use of the model.

## Rules guide design

The designer of a model is guided by the two rules into a simple mathematical derivation of the scale-reduction factors. The ratio of force in prototype to homologous force in model for each of the force-affecting influences is first expressed in terms of as many physical units (such as dimensions, time, physical properties, etc.) as are necessary to define the force ratio. Each such ratio of forces is thus made up of ratios of these physical units, which ratios are the desired scale-reduction factors. When all force ratios are equated according to Rule 2, mathematical relationships between the scale-reduction factors are established, which relationships, coupled with geometrical similarity, provide the necessary and sufficient conditions for similitude.

In general, the number of scale-reduction factors is greater than the number of equations between force ratios. The designer is then privileged to choose freely a number of factors equal to the excess, after which he may compute the remaining factors from the equations.

## Nomenclature

The following symbols, in which subscripts refer to the model, are adopted for the mathematical expressions:

$w$ and $w_m$ are densities of material, which are not necessarily uniform in each structure, but which vary in the same relative manner in model as in prototype.

$L$ and $L_m$ are linear dimensions of the whole or of corresponding parts of the two structures. The length scale-reduction factor $L/L_m$ is termed $n$.

$F$ and $F_m$ are homologous forces.

$V$ and $V_m$ are velocities of corresponding points.

$t$ and $t_m$ are time intervals, so defined that for periodic motion each represents the same phase change.

$E$ and $E_m$ are elastic moduli.

$e$ and $e_m$ are unit elastic strains.

$X$ and $X_m$ are forces arising from influences other than gravitation, elasticity or inertia.

$R$ and $R_m$ are densities of surrounding media.

$N$ and $N_m$ are viscosity coefficients.

## Expressing Rule 2

Before attempting to express Rule 2 in mathematical form, the force resulting from each of the influences affecting the structure needs to be expressed in terms of the physical units that are to be measured or controlled in the model. For example, the effect of gravitation is to cause a downward force through the center of gravity of each member. The force contributed by the weight of each structural member varies only as the weight of the member, which is a product of density and volume. The volume varies as the cube of a linear dimension. For general use, no distinction is made between length, breadth and thickness, since geometrical similarity prevails.

Thus, the *gravitational-force ratio* is given by

$$\frac{F}{F_m} = \frac{wL^3}{w_m L_m^3} \qquad (1)$$

If gravitation is the only influence affecting the structure, this is the only equation that needs to be fulfilled to satisfy Rule 2. In such a simple case, both the density and the size of the model may be chosen freely, and the relative forces on corresponding parts (not unit forces) are given by Eq. (1). Such a model might be one to determine the foundation pressures of a rigid structure on a rigid base.

However, weight is seldom sufficient to define the behavior of even the simplest structure, because all materials are more or less elastic and it is very seldom that accurate results can be obtained if elastic influences are omitted. Total elastic forces on a member are proportional to elastic modulus, deformation per unit length, and area. Since area is the product of two linear dimensions, the *elastic-force ratio* becomes

$$\frac{F}{F_m} = \frac{E e L^2}{E_m e_m L_m^2} \qquad (2)$$

If a structure is subjected to motion or if it is influenced by bodies in motion, and if there are varying velocities in these motions, the effects of inertia must be included. Inertial force,

being the product of mass and acceleration, varies as the density, volume and acceleration of a structural member. Since volume is the product of three linear dimensions and since acceleration varies as the velocity and inversely as the time, the *inertia-force* ratio is equal to

$$\frac{F}{F_m} = \frac{wL^3Vt_m}{w_mL_m^3V_mt} \qquad (3)$$

The ratio of forces arising from influences other than gravitation, elasticity or inertia must be added for generality. The number of such ratios may be several, all of which are included in the general term

$$\frac{F}{F_m} = \frac{X}{X_m} \qquad (4)$$

With these relationships established, it is convenient to give a mathematical expression of Rule 2. Deferring investigations into the validity of the rule, this expression, which results from equating the ratios in equation (1) to (4), is as follows:

$$\frac{F}{F_m} = \frac{wL^3}{w_mL_m^3} = \frac{wL^3Vt_m}{w_mL_m^3V_mt} = \frac{EeL^2}{E_me_mL_m^2} = \frac{X}{X_m} \qquad (5)$$

These equations are conveniently used in the form given, but Rule 1 demands that they be narrowed lest the designer of a model make an excessive number of free choices of scale-reduction factors. Maintenance of strict geometrical similarity under all phases of motion and under all degrees of load requires that strains be equal for prototype and model. Also, the length units which go with $t$ and $t_m$ to make up $V$ and $V_m$ must be proportional to $L$ and $L_m$.

Replacing $V$ and $V_m$ by their equivalent values, $\frac{L}{t}$ and $\frac{L_m}{t_m}$ and cancelling the equal strains $e$ and $e_m$, the narrowed equations are now

$$\frac{F}{F_m} = \frac{wL^3}{w_mL_m^3} = \frac{wL^3t_m^2}{w_mL_m^4t^2} = \frac{EL^2}{E_mL_m^2} = \frac{X}{X_m} \qquad (6)$$

If these equations are fulfilled, the stresses in the model are not merely related to but are exactly *equal* to corresponding stresses in the prototype. It is left for the designer to decide whether the use of stresses and strains in models differing by a constant factor from those in the prototype sufficiently disturbs geometrical similarity to disallow the departure. Should he decide that equal strains are not necessary, he may revert to Eq. (5) and obtain the privilege of extra choices of scale-reduction factors, a desirable privilege in many calculations owing to the rigid demands of Eq. (6).

## Additional force influences

Force influences other than gravitation, elasticity and inertia may be considered in a similar manner. For example, additional forces that vary directly as the velocity and surface area of a structural member may be present. The force ratio in this case, which will replace $X/X_m$ in Eq. (6), may be written

$$\frac{F}{F_m} = \frac{L^3t_m}{L_m^3t} \qquad (7)$$

The equations with this extension then give necessary and sufficient conditions for similitude.

Poisson's ratio influences must be equal for model and prototype. Exactness, therefore, necessitates equal Poisson's ratios for corresponding members of model and prototype. Since lateral expansion is often a minor influence, the designer will, when necessary, sacrifice exactness either with or without making corrections for discrepancies.

Buoyant effects depend upon the volumes of members and the densities of surrounding media. If media densities are $R$ and $R_m$ for prototype and model, respectively, the buoyant-force ratio, which will replace $X/X_m$ in Eq. (6), becomes

$$\frac{F}{F_m} = \frac{L^3R}{L_m^3R_m} \qquad (8)$$

It will be seen that this is the same as the gravitational-force influence.

The procedure for handling additional force influences is thus shown to be similar regardless of the origin of the force. Even the effects of temperature changes may be expressed and included, either to replace or to form a part of $X/X_m$ in Eq. (6).

## Application to model design

*Steel Bridge*—First the problem of designing a simple model of a structure influenced only by gravitation and elasticity, such as an all-steel bridge on a rigid foundation, will be considered. The first, second and fourth expressions of Eq. (6) must be fulfilled. Thus, there are two equations and four scale-reduction factors, which factors are force reduction, density reduction, length reduction and modulus-of-elasticity reduction. As will be seen, these so-called scale-reduction factors are not always reductions in amount, since in some cases the physical units are greater in the model than in the prototype. In simple mathematical terms, there are now two equations and four unknowns. Two of the unknowns can therefore be chosen freely, after which the remaining two are fixed by the equations.

Under typical circumstances, the designer chooses first the scale-reduction factor for length, because this is governed by considerations of economy, ease of measurements, etc. After deciding to make the model $1/n$ times as long as the prototype, he has one choice yet to make. The designer chooses $E$ equal to unity, hoping to use in the model materials identical with those in the prototype. From the equations he then computes the force-reduction factor, which he finds to be $n^2 : 1$, a natural consequence since stresses are to be equal. The density is found to be $n$ times as great in the model as in the prototype, a condition the designer did not fulfill when he chose to make the model of the same material as the prototype.

If the model to be used is 1/100 of full size and the material of the prototype weighs 500 lb. per cu.ft., it would be necessary that the material in the model weigh 50,000 lb. per cu.ft. Since no such material is available, the designer has three alternatives:

1. Weights may be added to the model to correct for the lack of density. If these weights are placed at close intervals, the effect can be made very nearly the same as if the material were more dense, without interfering with the dimensions of the members. This plan has the advantage that if identical materials are used as planned, the model is no safer than the full structure, and overloading tests can be made to indicate the safety of the structure without recourse to involved interpretations of results.

2. The second alternative is to assume that the strains and deflections in the loaded structure are not sufficient to alter materially the geometrical shape, and therefore not to insist on equal strains in prototype and model. In such a case the expressions in Eq. (5) may be used; and if densities are chosen equal, the strains are $n$ times as great in the prototype as in the model. This alternative has the disadvantage that strains are small and difficult to measure.

3. It may be advisable to resort to an indirect use of the model. A model may be constructed which approaches as nearly as possible the requirements for similitude. Parallel calculations of behavior may then be made for this model as constructed and also for a model that would meet the requirements of similitude. After making the necessary observations on the model, simple comparisons may be made which provide an indirect check on the calculations for the full-size structure.

It is interesting to consider what modifications would need to be made to make the model suitable for dynamic tests. The third expression of Eq. (6) would then be included. Assuming that the high-density requirement has been met in the model, one additional scale-reduction factor, that for time, has

been introduced and one equation has been added. Therefore, the model that is constructed correctly for the influences of gravitation and elasticity is also perfectly suited to dynamic tests. The time-reduction factor is computed from the extra equation, and a time interval of 1 sec. in the prototype is found to correspond to $1/\sqrt{n}$ seconds in the model. Thus if the model of a bridge were built to 1/100 scale, the effect of a foundation vibration of one second period on the bridge would be the same as the effect on the model of a foundation vibration of 1/10 sec. period and of 1/100 as large an amplitude. This is assuming, of course, that the model is 100 times as dense as the bridge, or that weights are added at close intervals to simulate this greater density.

*Concrete Dam*—In designing the model of a concrete dam subjected to water loading, Eq. (5) may be used. Again it is found that exactness is impracticable in that the condition of proportional deflections and equal strains would ordinarily make measurements difficult in the model. Some material such as celluloid or rubber is therefore chosen to facilitate measuring. Although the properties of these materials can be varied somewhat, ordinarily the choice of material fixes the density and modulus of elasticity of the model. In general, the density of loading liquid and density of model must be in the same proportions as are the density of water and the density of the full-size dam. However, if perfect elasticity is assumed, if there are no joints which may open, and if only the effect of loading is being investigated, the weight of the dam plays no part since it does not change during the test. In such a case the density of the loading liquid only need be considered.

It is interesting to note that if the gravitational effect of the loading liquid is included correctly (making $w$ the density of loading liquid) by satisfying the first two terms of Eq. (6), the effect of the lateral fluid pressure is automatically included. Therefore, the first, second and fourth terms of Eq. (5) provide the necessary and sufficient conditions for similitude in the present problem. Obviously Eq. (6) cannot be applied here because strains will be greater in the model than in the prototype. First the length-scale reduction is chosen from considerations of economy and accuracy of measurement. The density of loading liquid and elasticity of the model are fixed by choosing the material for the model. The scale-reduction factors for strains and forces, which are the only ones remaining, are computed from Eq. (5). Thus all requirements are fulfilled for this special case.

It may be desired to adapt this model of a concrete dam for dynamic studies. Considering first the condition of unloaded dam, the third term of Eq. (5) is included, thus supplying an additional equation and two additional physical units. In reality, time is the only new physical unit, since velocity can be defined in terms of length and time. The scale-reduction factor for time can be computed from the additional equation, and thus again it is seen that the model, which is correctly designed for elastic and gravitational influences, is also correctly designed for dynamic influences, so far as the dam itself is concerned.

The use of the model for dynamic tests with fluid load introduces new influences that cannot be discussed here. However, since it has been shown mathematically by Westergaard that under dynamic influences an amount of water may be considered to act as a unit with the dam, the model may be constructed and tested with weight added to the upstream side. The amount of this added weight may be computed from the Westergaard equations, which have been confirmed by several mathematicians. The model may then be used to determine the natural period of vibration and the amplitude under different conditions of forced vibration. Such a model might serve to indicate the effect of an earthquake of short duration, which would not last long enough to bring the dam to a steady state of vibration. To whatever stresses are found, there must be added the effect of normal water load.

## Hydraulic structures

In hydraulic problems, the viscosity of the liquid exerts an influence that often must be considered. Viscous forces are proportional to the first power of both length and velocity, as well as to the first power of the viscosity coefficient $N$. When velocity is written as length divided by time and the resulting expression is introduced as the general term of Eq. (6);

$$\frac{F}{F_m} = \frac{wL^3}{w_mL_m^3} = \frac{wL^4t_m^2}{w_mL_m^4t^2} = \frac{NL^2t_m}{N_mL_m^2t}$$

A simple calculation will show that these equations cannot be fulfilled if the same fluid is used for the model as for the prototype. There are, in fact, fewer unknowns than there are equations, so the equations conflict. If viscosities are equal, the density of the fluid for the model must be greater than that for the prototype by the square root of the scale reduction for lengths; or if the densities are equal, the viscosity of the fluid for the model must be less by this same proportion.

It will be noted that in this example an attempt is being made to have the model meet the exacting demands of three different influences acting simultaneously. Very seldom is such a versatile model required. Usually either viscous flow will predominate as in a stream of very low gradient where little or no acceleration is found, or acceleration will predominate as in a spillway where little or no retardation of flow due to simple viscous forces is found. In the case of turbulent flow, which is perhaps the most important, the force varies as a higher power of velocity, and the equations may be fulfilled for both accelerating and frictional influences. Thus, the designer of a model must use a certain amount of judgment in preparing his plans, since it is shown that some conditions can be met while others cannot be met exactly. He must determine for his prototype the relation between each force influence and the various physical units and be reasonably sure that the same relation exists in the model.

In some cases, force influences become important in a model that are negligible in a prototype. Such an influence is that of surface tension in a hydraulic model, which tends to make the model behave differently from the prototype. Obviously this is in violation of Rule 2, which demands that force influences be in a given proportion, regardless of origin. The danger of making a model too small and of dealing with too small velocities in the model should not be overlooked.

## Validity of general rule

The validity of the general rule for static conditions is very nearly obvious. Since for the model each contribution to force is reduced by the same factor, combined forces are also necessarily reduced by the same factor.

Although similar reasoning may lead to a similar conclusion for dynamic conditions, the validity of application may be checked by investigation of special examples of vibration, as, for instance, a simple elastic member in alternate compression and tension. The natural period of vibration for such a member is computed, as are also its strains and displacements for assumed conditions. The dimensions are then reduced $n$ times. The natural period, strains and displacements are again computed for the same elastic modulus. Provided that the density in the smaller member is $n$ times as great as in the larger member, the new period is found to be $1/\sqrt{n}$ times that of the larger member, displacements are found to be proportional to lengths, and strains are found to be equal at corresponding times. Thus Eq. (6) is found to be both necessary and sufficient for similarity.

Perfect agreement is also found when moduli of elasticity differing in small and large member, are substituted.

Another example may be considered in which members vibrate transversely. If it is borne in mind that the force ratios are for total forces on corresponding but not equal areas, there will again be found scale-reduction factors that satisfy Eq. (6). The moments of inertia provided by geometrical similarity prove to be correct without adjustment.

Torsional vibration is also consid-

ered. With proper use of shearing modulus of elasticity and by comparison of displacements of corresponding points only, factors are again found that satisfy Eq. (6). Also polar moments of inertia, provided by geometrical similarity, are correct without adjustment. Incidentally, this study reveals the necessity of making the ratio of shearing moduli equal to the ratio of Young's moduli when torsional influence is present simultaneously with direct stress.

The above studies of free vibration having been made, the investigation is extended to forced vibration. For simple harmonic forcing vibrations, Eq. (6) are again found to give correct scale-reduction factors. In fact, forced vibration is in every way similar to natural vibration so far as model study is concerned. The fundamental requirement is that the force scale-reduction factor for the forcing vibrations be the same as for all other forces. This is accomplished by making the amplitude of the forcing vibration $1/n$ times as great for the model as for the prototype.

These agreements are not startling in view of the fact that the equations for vibration conditions, as derived by Timoshenko, are founded upon the same relations as are Eq. (6). However, Timoshenko's equations being well established, the agreements increase confidence in the general rules.

### Summary

An attempt has been made to show that two rules define the necessary and sufficient conditions for similitude and that when these rules are translated into mathematical terms they provide a useful tool in the design of a model. It is necessary for the designer to determine the relations between forces and other physical units for each influence that affects the structure, so that he may make use of these rules. It has been shown that exact similitude can seldom be realized, especially in hydraulic models, and therefore it is suggested that caution be exercised in the use of approximations that do not err on the side of safety.

# Similitude in Hydraulic Models

## *A Discussion of Mr. Carlson's Paper*

By K. C. Reynolds
*Assistant Professor of Hydraulics, Massachusetts Institute of Technology*

There exist five physical forces that operate in the universe (1) terrestrial gravitation; (2) universal gravitation; (3) internal fluid friction; (4) elastic forces; and (5) capillary forces. Each of these five physical forces establishes its own law of similitude, and all physical phenomena can be reduced to these five laws. Often it is found that more than one physical force is acting. Thus, a perfect fluid might be imagined or one in which the viscous forces or those due to internal fluid friction are not present. If such a fluid were subjected to wave action, the resulting physical force would be due to terrestrial gravitation alone. However, since all fluids do have internal fluid friction, wave action of a fluid would involve two physical forces—terrestrial gravitation and internal fluid friction.

Professor Carlson has given an equation (Eq. 6) which furnishes the ratio of the force on the prototype to that on the model when each of the physical forces is acting. For a particular case, it then becomes necessary to decide what conditions might be simplified so as to obtain a solution. This is another way of saying that certain physical forces will be neglected, temporarily if not permanently.

Another way of attacking the problem is to consider only one physical force to be acting and to determine the relationship of the various elements. The inertia forces will always be acting. Newton stated the fundamental law for these forces in his second law of motion which is that force equals mass times acceleration. Then the ratio between the inertia forces for prototype and model will be

$$\frac{F}{F_m} = \left(\frac{M}{M_m}\right)\left(\frac{a}{a_m}\right)$$

or since acceleration is a length divided by the square of a time,

$$\frac{F}{F_m} = \left(\frac{M}{M_m}\right)\left(\frac{L}{L_m}\right)\left(\frac{t_m^2}{t^2}\right)$$

If the force is due to terrestrial gravitation, force equals mass times $g$, and by equating these two ratios for the forces

$$\frac{F}{F_m} = \left(\frac{M}{M_m}\right)\left(\frac{L}{L_m}\right)\left(\frac{t_m^2}{t^2}\right) = \left(\frac{M}{M_m}\right)\left(\frac{g}{g_m}\right)$$

gives

$$\frac{t}{t_m} = \sqrt{\frac{L}{L_m}\frac{g_m}{g}}$$

The resulting law is known as Froude's Law for corresponding times when terrestrial gravitation alone is acting.

Velocity is a distance divided by a time so that, considering the ratio of velocities and using the ratio of times as found, one obtains Froude's Number —dimensionless.

$$V = \frac{L}{t}$$

$$\frac{V}{V_m} = \frac{L}{L_m}\sqrt{\frac{L_m}{L}\frac{g}{g_m}} = \sqrt{\frac{L}{L_m}\frac{g}{g_m}}$$

or $$\frac{V^2}{Lg} = \frac{V_m^2}{L_m g_m}$$

Similarly other dimensionless numbers may be found for the other four physical forces. These are shown in the accompanying table which also gives various similitude relationships for each force condition.

RELATIONSHIPS (IN TERMS OF SCALE OF LENGTH) BETWEEN VARIOUS QUANTITIES IN THE PROTOTYPE AND THE CORRESPONDING QUANTITIES IN THE MODEL

| Physical Forces Acting | Universal Gravitation | Terrestrial Gravitation | Elastic Forces | Capillary Forces | Internal Fluid Friction |
|---|---|---|---|---|---|
| Name of Governing Model Law | Thomson's Law | Froude's Law | Cauchy's Law | Weber's Law | Reynolds' Law |
| Dimensionless Statement of Law | $T = t^2C\rho$ | $F = \frac{V^2}{L_g}$ | $C = \frac{V^2\rho}{E}$ | $W = \frac{V^2L\rho}{S}$ | $R = \frac{VL}{\nu}$ |
| Quantities: | | | | | |
| Work | $\lambda^3$ | $\lambda^4$ | $\lambda^3$ | $\lambda^2$ | $\lambda^1$ |
| Forces | $\lambda^1$ | $\lambda^3$ | $\lambda^2$ | $\lambda^1$ | $\lambda^0$ |
| Loads per Length | $\lambda^3$ | $\lambda^2$ | $\lambda^1$ | $\lambda^0$ | $\lambda^{-1}$ |
| Loads per Area | $\lambda^2$ | $\lambda^1$ | $\lambda^0$ | $\lambda^{-1}$ | $\lambda^{-2}$ |
| Accelerations | $\lambda^1$ | $\lambda^0$ | $\lambda^{-1}$ | $\lambda^{-2}$ | $\lambda^{-3}$ |
| Velocities | $\lambda^1$ | $\lambda^{0.5}$ | $\lambda^0$ | $\lambda^{-0.5}$ | $\lambda^{-1}$ |
| Times | $\lambda^2$ | $\lambda^{0.5}$ | $\lambda^1$ | $\lambda^{1.5}$ | $\lambda^2$ |

(lambda) $\lambda$ = linear dimension of prototype / corresponding linear dimension of model
$t$ = time
$G$ = constant of universal gravitation = $\left(648 \times 10^{-12} \frac{m^4}{\text{sec.}^4\ \text{kg.}}\right)$
(rho) $\rho$ = density
$V$ = velocity
$L$ = linear dimension
$g$ = acceleration due to gravity
$E$ = modulus of elasticity
$S$ = surface tension = $(74 \times 10^{-4}$ kg./m)
(nu) $\nu$ = kinematic viscosity = coefficient of viscosity / density

# Bullwheel-Mounted Cutter on Hydraulic Dredge

## Grand Canal draining Mexico City being enlarged by hydraulic dredge with cutter-swing independent of hull and walking stern spud

By V. J. Milkowski
*Engineer, Morris Machine Works, Baldwinsville, N. Y.*

AN UNUSUAL TYPE of dredge was installed recently by Mexico City for cleaning out and enlarging the Grand Canal, which is the main drainage artery of the city. This dredge was designed to work in a narrow channel between high banks, which prohibited the usual maneuvering operations of hydraulic dredging.

Mexico City is located in a valley, about 70 miles long, surrounded by ranges and peaks of volcanic origin. The natural drainage of this valley is very poor, and the Grand Canal takes the discharge from the city sewer system and delivers it to a tunnel that pierces the mountains surrounding the valley. [A general description of this canal was published in *Engineering News*, April 5, 1890, pp. 313 and 339, and further accounts appeared in the same journal in 1891, 1894 and 1895. —Editor]. Fig. 1 shows a typical cross-section of the canal. Its total length, from the end of the sewer to the entrance to the tunnel, is 47½ km. The slope is approximately 0.00019. At the upper end the bottom of the canal is about 7½ m. below the natural ground level, while at the tunnel entrance, it is about 20 m. below. The whole region is of volcanic formation, and while in most places the material is very soft, especially when wet, so that difficulties are experienced on account of the banks caving in, there are streaks or layers of gypsum and other hard materials in many places, which require blasting before a dredge is able to excavate them.

### General design of dredge

On account of the small width of the canal, it was impossible to use a hydraulic dredge of the usual design. On the other hand, due to the necessity of delivering the excavated material at some distance from the canal prism, it was impracticable to consider other types of excavating and dredging equipment. To meet the various requirements and conditions of this job, a special type of dredge was designed by the engineers of the Morris Machine Works and submitted to the engineers of the Secretariat of Communications and Public Works, who are in charge of this work. The general design of the dredge is shown in Fig. 1. A novel feature of this design is that the ladder is arranged to swing independently of the hull, while the dredge is held stationary in the cut by means of three spuds.

The dredge was designed for an average capacity of 90 cu.m. of material per hour, and is capable of delivering either through 480 m. of discharge line with a lift of 12 m. above water surface, or through 210 m. of discharge line with a lift of 27 m. above water surface. The depth of excavation below water surface is stipulated at 4 m., and the draft is not to exceed 1.27 m.

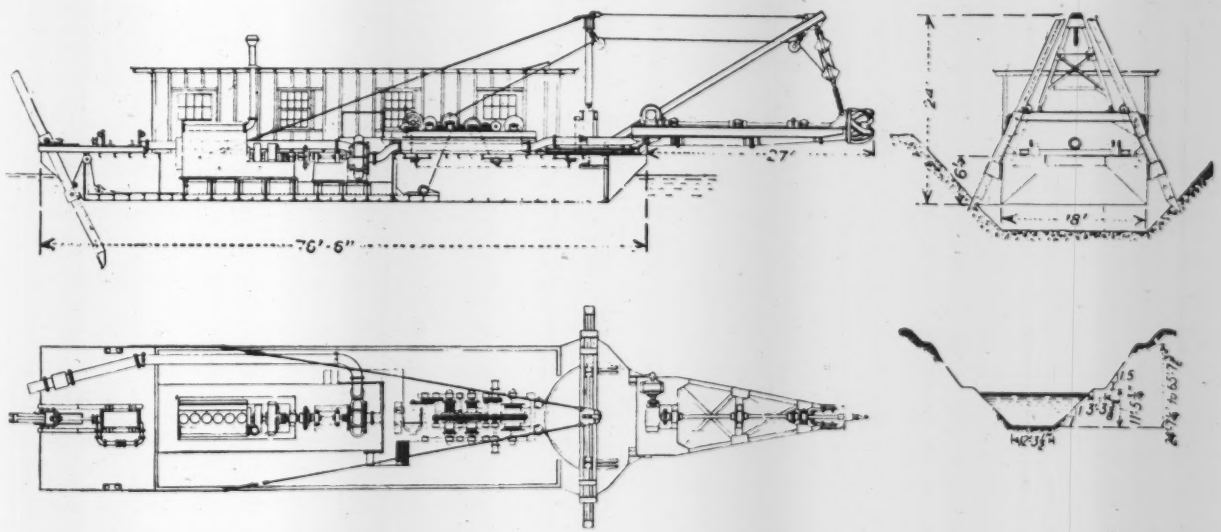



**FIG. 1—SPECIAL DREDGE for enlarging Grand Canal, which drains Mexico City. Dredge has a swinging cutter and walking stern spud. Note cross section of canal.**

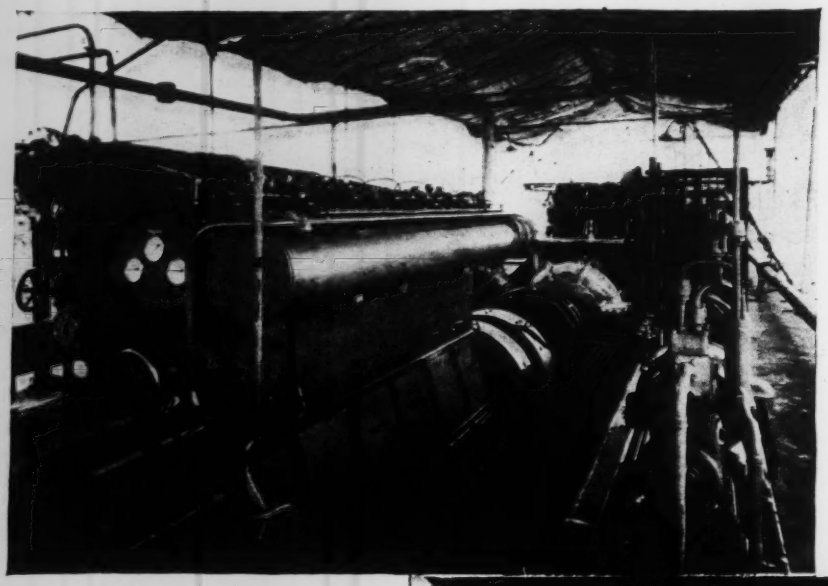
### Dredge equipment

The dredging pump is a 12-in.-diameter, suction and discharge, heavy-duty pump with ball bearings designed for a maximum speed of 600 r.p.m. The engine is a six-cylinder diesel developing 590 hp. at 600 r.p.m. at sea level, and about 472 hp. at the altitude of Mexico City, 7,000 ft. above sea level. Between the engine and the dredging pump there is a 75-kw., 125- to 250-volt dc. dynamo, which supplies current for the various auxiliaries.

The pump is directly connected to the engine through a combination of magnetic clutch and a special flexible coupling. This arrangement of clutch and flexible coupling eliminates criticals at the usual operating range, and makes it possible to shut down the pump without shutting down the engine or the dynamo.

The cutter ladder, which is 27 ft. long, is hinged from a turntable or bullwheel mounted on the forward end of the dredge, and is arranged to swing 30 deg. to either side of the center line of the dredge. This construction permits of raising and lowering the cutter to vary the depth of excavation, and permits of swinging the cutter horizontally through an arc of 60 deg., on a radius of about 34 ft. when in a horizontal position. The cutter is driven by a 30-hp. motor mounted on the ladder, through a worm-gear reducer, giving the cutter a maximum speed of about 30 r.p.m.

The hoist is provided with six drums,



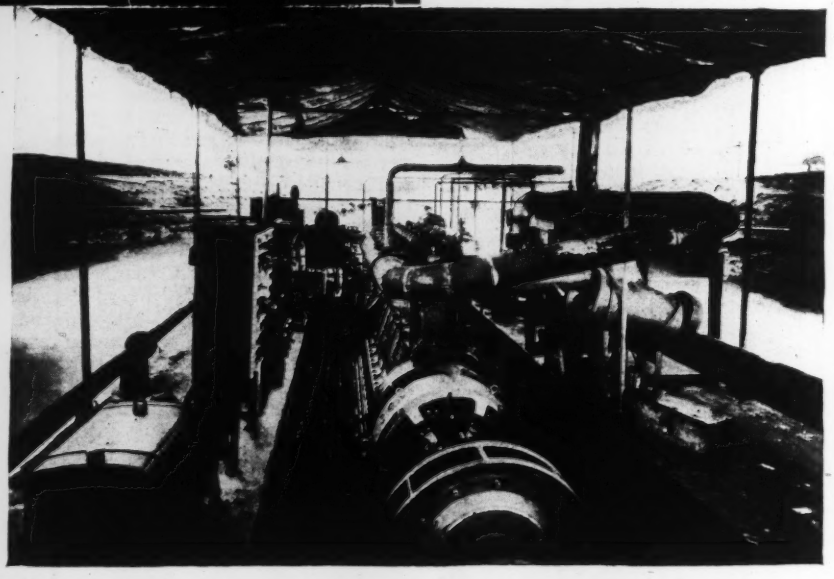


FIG. 2—OPERATING MACHINERY for Grand Canal dredge, showing (right) pump and operating clutches looking forward, and (above) diesel engine and switchboard looking aft.

and is driven by a 20-hp. motor. The two forward drums are used for swinging the turntable or bullwheel on which the cutter ladder is mounted. One drum is used for raising and lowering the cutter ladder. Two additional drums operate the two forward spuds, and the sixth raises the stern spud. The two forward drums for swinging the turntable are provided with brakes interlocked with limiting switches so as to limit the swing of the cutter ladder to a maximum of 30 deg. to either side of the center line.

The two forward spuds are carried in inclined guides and are provided with ratchets and pawls for pinning up when the ladder is swung from one side to the other. The purpose of these spuds is to hold the forward end of the dredge securely in position when the cutter is in operation. The stern spud is used both for holding the stern of the dredge in position when excavating, and for advancing the whole dredge forward in the cut. The advance forward is made by kicking this spud, this being accomplished by means of a hydraulically operated thrust cylinder or ram. This thrust cylinder is controlled by an electrically operated four-way valve. In operation, when it is desired to move the whole dredge forward, the cutter and the two forward spuds are raised off the bottom; the whole dredge is then advanced forward the desired distance by kicking the stern spud; the two forward spuds are then dropped to the bottom; the stern spud is raised and brought back to its previous position and dropped to the bottom. Digging is then resumed in the new position.

To supply water to pump bearings, for operating the thrust cylinder, for priming, etc., there are two 3-in. centrifugal pumps, each directly connected to a 10-hp. motor. Only one pump is used continuously the other serving as a spare.

A very complete set of auxiliaries is provided with the engine such as compressor and air tanks for starting, oil transfer pumps, oil filters, lubricating-oil purifier, etc. Because the water in the canal is too dirty to use in the cylinders for cooling, an independent circulating system with a recooler is provided. Another cooler is provided to cool the lubricating oil. A 5-kw. gasoline-engine-driven dynamo is provided to furnish current for lights, for operating the bilge pumps, and for operating the starting compressor when the main engine is shut down. A 6-in. centrifugal pump directly connected to a 60-hp. gasoline engine is provided to furnish jets for trimming the slopes of the canal above water surface.

The hull is steel, 76½ ft. long, 18 [illegible] wide and 6 ft. deep. It is provided with rakes on both ends and is subdivided into several compartments, two of the compartments serving as fuel-oil tanks and two as fresh-water tanks. The deck house, instead of being made of structural steel as shown in Fig. 1, was made of canvas supported on pipe framing, in order to go under bridges with a clearance of 2.5 m. with the minimum amount of dismantling.

The discharge line beyond the dredge is 12-in., light-gage, spiral welded pipe. The flexible portion of the discharge line—that is, the part between the dredge and the shore—consists of two lengths of straight pipe with one 90-deg. long-radius elbow connected with three long rubber sleeves, the two lengths of pipe being supported on independent pontoons. This provides sufficient flexibility to permit an advance of 45 ft. before requiring any change in the shore line. The shore line is connected up with special couplings.

The dredge is operated from a platform immediately back of the hoist. All motor controls and electric controls are located on this platform in line with the levers operating the frictions and brakes on the hoist. It was built and assembled in a pit excavated adjacent to the canal prism. When completed, the pit was flooded, and the dredge dug its way out into the canal prism. It was put in operation early in 1933, and after a severe test was accepted as satisfactory by the purchaser. It exceeded the guaranteed output on the test by a considerable margin, and continues to give satisfactory service. The construction of the hull and the installation of the machinery were handled by the Anahuac Machinery Co. S. A., of Mexico City, who acted as agents on the behalf of the Morris Machine Works.

# Revamping an Old Street in Springfield, Mo.

## Bad section of through-city route modernized to main-road standards through skilled salvage of old pavement by resurfacing and widening

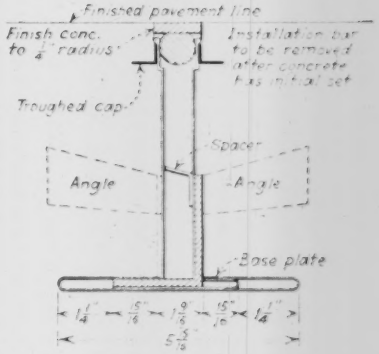
By Walter G. Hill
*Assistant Division Engineer of Construction, Missouri Highway Dept., Springfield, Mo.*

THE National Industrial Recovery Act $400,000,000 emergency road fund gave the city of Springfield Mo., an allotment for a municipal extension of the federal-aid highway system. The street selected and approved by the Bureau of Public Roads, the Missouri State Highway Commission and the Mayor and Council for Springfield was College St., the main traffic artery along which U. S. Route 66 enters the city from the west.

### Existing pavement

One of the first concrete pavements in Springfield was constructed on College St. between New Ave. and Kansas Ave., a net length of 1,924 ft. The navement was completed in July, 1913, by the Ozark Engineering & Construction Co., of Joplin, Mo., under the direction of C. E. Phillips, city engineer of Springfield, at a total cost of $5707.70. It was an 18-ft. portland cement concrete slab with 4-ft. earth shoulders and without curbs. The pavement was of two-course type consisting of a 4-in. base course of a 1:2:4 mix with coarse aggregates (limestone) passing a 2½-in. screen and a 1-in. top course of a 1:1:2 mix with coarse aggregates (limestone) passing a ½-in. ring. The concrete was hand-mixed and hand-finished against 1x5-in. oak boards set 18 ft. apart. The bottom layer was placed on a rocky subgrade, and before it had set the top layer was placed upon it. Poured-asphalt transverse expansion joints 5 in. deep and ½ in. thick were placed at intervals of 100 ft. This concrete pavement has been in continuous use for 21 years, but of late years it had become badly broken up and disintegrated under the extremely heavy traffic to which it had been subjected.

In 1920 a contract was awarded by the Missouri state highway department to the Springfield Special Road District to grade, drain and surface College St. from the end of the concrete pavement at Kansas Ave. (then the west corporate line of Springfield) in a southwesterly direction through Republic to the Christian County line, a net distance of 16.54 miles. The surfacing consisted of a clay-bound macadam surface course on a broken-stone base course. The pavement was 16 ft. wide with a thickness at the center of 10 in. and of 7 in. at the edges, with 4-ft. earth shoulders. Where the old macadam base could be utilized as a base, a macadam surface course only was constructed on it. The surface course consisted of a single layer of crushed local fieldstone, which was spread uniformly on the prepared base course, harrowed, sprinkled and rolled. This work was completed in May, 1923, under the direction of H. P. Mobberly, division engineer, Missouri state highway department, at a total cost of $120,289.27. This macadam road served for 2½ years.

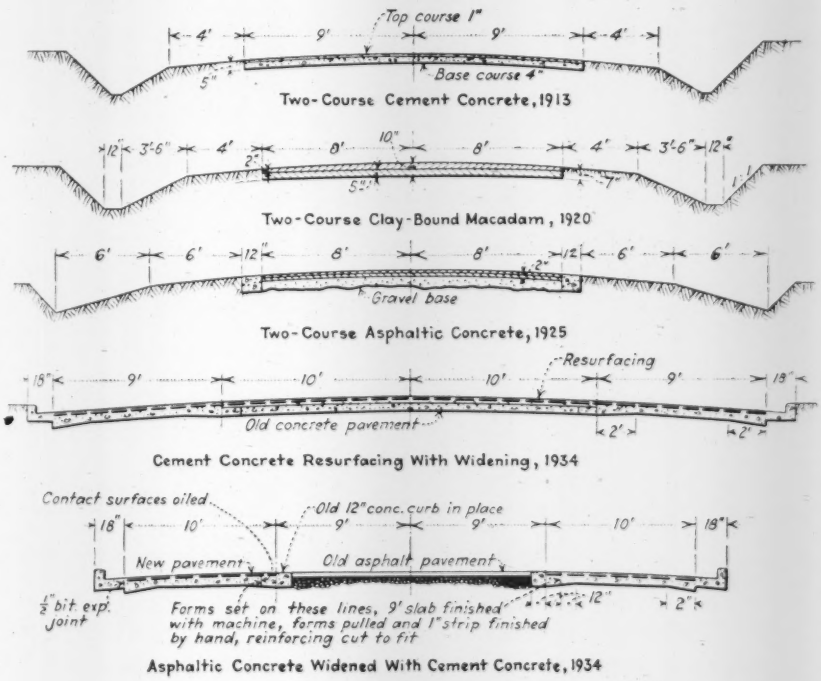



**EXPANSION JOINT** of metal-air type used on pavement reconstruction at Springfield, Mo.

In May, 1925, a contract was awarded by the Missouri state highway department to the Kaw Paving Co., of Topeka, Kan., to grade, drain and surface this macadam road from the end of the concrete pavement on College St. in a westerly direction through Nichols to the Frisco grade-crossing, a net distance of 3.496 miles. The surfacing consisted of a 1½-in. asphaltic concrete surface course on a 2-in. asphaltic binder course on a reconstructed gravel base. The pavement was 16 ft. wide with 12x9-in. reinforced-concrete protection curbs on each side with 6-ft. earth shoulders. This work was completed in November, 1925, under the direction of H. P. Mobberly, division engineer for the Missouri state highway department, at a total cost of $63,761.19. This asphaltic concrete road has been in continuous use for 8½ years.

In April, 1926, the city limits of Springfield were extended approximately 1.2 miles west (the present city limits); and in September, 1926, College St. was marked by the Missouri state highway department as a part of U. S. Route 66. Consequently, College St. became a heavily traveled primary

**OLD PAVEMENT SECTIONS** at Springfield, Mo., salvaged by resurfacing and widening in 1934.



**OLD CONCRETE** showing disintegrated portions removed and gaps squared up for replacement.

**FILLING CUTS** in top course of old concrete with grout. Where full slab depth was cut out, fill was with concrete.

route in addition to being a heavy-duty city thoroughfare. The Missouri state highway department's traffic census of July, 1931, showed that this stretch of highway westward from Springfield carried the heaviest traffic in this part of the state, or a total of 4,107 vehicles per day—24-hour count. The CWA traffic census of March, 1934, showed a total of 3,288 vehicles per day (12-hour count), and that this traffic was composed of 2,469 passenger cars, 742 trucks and 78 buses, which was an increase of approximately 40 per cent. While the 1925 asphaltic-concrete section of pavement withstood the increased volume of traffic in very good shape with state maintenance, the 1913 portland cement concrete section of pavement became rough, due to cracks that had some city maintenance.

## Resurfacing concrete

In January, 1934, the Missouri state highway commission, after conferring with the city officials, decided to resurface and to widen with concrete the old portland cement concrete pavement from New Ave. and also to widen with concrete the old asphaltic concrete pavement from Kansas Ave. to West Boulevard, or to improve College St. for a net distance of 1.12 miles in order to develop the continuity of the state highway through town. Plans were drawn up by the highway department to state standards and submitted to the city and also to the Bureau of Public Roads for approval. Bids were asked for as state work, and a contract was awarded to the Imperial Construction Co., of Leavenworth, Kan. Work on the project was started on April 7.

One of the requirements of the contract was that the center strip be reconstructed or constructed in advance of the outside widening. The old slab was first thoroughly cleaned by scrubbing with water and street push brooms. Next, all of the asphalt patches were removed, and where the old slab was found to be completely disintegrated under the thick asphalt patches, sections were cut out, squared up with a pavement breaker and removed. Approximately 1,641 sq.yd. of the old slab were removed out of a total of 3,805 sq.yd. However, most of these base removals, 862 sq.yd., were at street intersections, at the railroad grade-crossing and at the ends of the slab where changes were necessary. Such cut-out places were replaced with new concrete of a 1:2:3½ mix of a minimum thickness of 5 in., to form a base. Where the old concrete base course was intact such places were sealed with a cement grout of a 1:2 mix, as were all of the cracks in the old slab.

Due to the fact that the outside edges of the old slab were very irregular, the old pavement varied in width from 17.7 to 18.5 ft., and regular paving-steel side forms 9 in. high were set 10 ft. each side of the transit line, or approximately 1 ft. beyond the edges of the old slab. These side forms were set with the tops to a finished grade line, which was laid along the top of the existing old pavement so as to maintain a minimum of 4 in. over and above the high places on the old surface, with the changes in grade limited to a minimum of 25 ft.

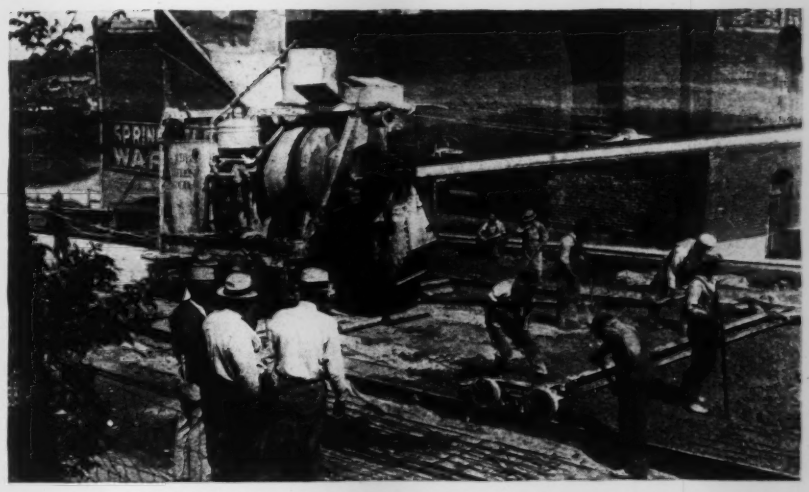
After these side forms had been set to true line and grade, the spaces between the forms and the edges of the old slab were filled with concrete of a 1:2:3½ mix to the top of the old slab, thus extending the base to a width of 20 ft. Before the top course (resurfacing) was poured, the entire top surface of the base course was again scrubbed clean to insure a distinct plane of separation between the base course and the top course. The top course consisted of a 1:2:3½ mix by weight with wire fabric mats installed 2 in. below the top surface by the strike-off method, with premolded bituminous longitudinal center joint and premolded bituminous transverse expansion joints placed at intervals of 79 ft. 4 in. laid on a layer of building paper to prevent bond between the old and the new pavement. Batches were delivered in trucks from a central proportioning plant to a 27-E paver on the slab, and the concrete was finished by a 20-ft. finishing machine operating on the steel side forms. By this method, a true machine finish on the resurfacing was secured that would meet the straight-edge requirements of a ¼-in. variation in 10 ft.

After the top course had gained its designed strength (600 lb. modulus of rupture as determined by tests on beam breaks), the side strips (widening) adjacent to the 20-ft. resurfacing were poured. These side strips were poured in both 8-ft. and 9-ft. strips depending upon existing conditions. The new side strips were of a modified 9:7:9-in. section, of a concrete of a 1:2:3½ mix by weight, with wire fabric mats and with metal transverse air-expansion joints with transload base installed at intervals of 79 ft. 4 in. Two layers of tar paper were installed against the edges of the two-story concrete to insure a vertical slippage plane between the resurfacing and the widening. The concrete in the widening was finished with a 9-ft.

finishing machine operating with a double-flanged wheel upon the top of the extreme outside steel form and with a flat wheel upon the surface of the new resurfacing course. The variation in the width of these side strips was due to the fact that it was necessary to provide 1½ ft. outside the forms to the sidewalks in order to operate the tamper and screeds on the finishing machine.

A concrete curb and gutter with a 6-in. curb 6 in. high and with a 1-ft. gutter were placed on the outside of the widening on each side, which made the total width of the roadway 40 ft. between faces of curbs. A concrete of a 1:2:3½ mix was delivered by trucks in wet batches, dumped on a metal plate at the site, placed in steel curb forms and finished by hand without any mortar coat. A ½-in. premolded bituminous joint was placed longitudinally between the curb and gutter section and the widening section, and 1-in. premolded expansion joints were placed at intervals of 79 ft. 4 in. opposite those in the pavement slab and also at the beginning of all curb returns. All concrete curb and gutter was poured after the completion of the slab work.

The widening of the old asphaltic concrete pavement consisted of two side strips of concrete of a modified 9:7:9 section 10 ft. wide with concrete curb and gutter.



NEW CONCRETE laid on building paper to provide slippage plane between resurfacing and repaired old pavement slab.

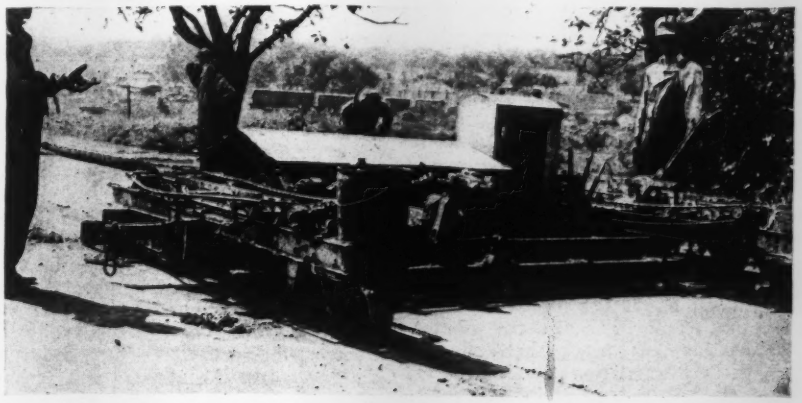
Practically the same method of construction was followed on this widening—that is, setting two lines of steel forms for each strip on which to operate a 9-ft. finishing machine on account of the variations in the top surfaces of the concrete protection curbs. The exception was that dummy transverse expansion joints consisting of a hollow wooden box form were set temporarily and finished over. After the finishing machine had passed over the forms and finished the 9-ft. strip, the inside forms and the dummy joints were removed immediately. The 10-ft. metal air-expansion joints were set in their proper places and the edges of the new concrete were broken down to the wire mesh. Additional concrete was then placed in the 1-ft. strip, a 1-ft. strip of wire mesh placed, and the concrete finished by hand, securing a monolithic 10-ft. slab.

Arkansas River sand was used for the fine aggregate, and Burlington limestone was used for the coarse aggregate. The average cement factor was 1.47 bbl. per cubic yard, and the average water-cement ratio was 0.733. The curing agent used was calcium chloride.

The Missouri Pacific Railroad was crossed at grade on a skew which made the length of the crossing 102 ft. Reinforced-concrete planks were poured in place with a one-sack mixer, and the expansion joints were poured with bituminous filler after the crossing was completed.

The Jordan Creek Bridge, a double 14x10½-ft. box culvert, was extended 6 ft. 1 in. on the right. The sidewalk, curb and gutter were built with the culvert extension, and a 4-in. wearing surface was placed over the old bridge floor at the time of paving.

The project was completed on June 16, 1934, at a total cost of $57,698.85. M. R. Amerman was in general charge for the Imperial Construction Co. The work was done under the direction of the Missouri state highway department, of which T. H. Cutler is chief engineer, D. B. Levi engineer of construction, R. M. Whitton division engineer, W. O. Hill assistant division engineer of construction, and J. R. Parker project engineer.



MACHINE-FINISHING widening strip with 9-ft. finisher having one wheel without flange to ride on completed pavement.

COMPLETED STREET after resurfacing and widening old pavement at Springfield, Mo.

# Computation of Floodflows by Slope-Area Method

## In determining river discharge from high-water marks, roughness coefficient varies, corresponding to value of wet perimeter

By A. H. Davison
*Hydraulic Engineer, Glens Falls, N. Y.*

IN THE ABSENCE of gaging-station records of floodflows, conditions may require that such flow be computed from field observations. Usually some reasonable value of $n$, the coefficient of roughness of the channel, is assumed for the conditions of the problem and a corresponding value of discharge computed by using the Chezy formula. Certain deficiencies in results have been noted by experience with the usual method of computation. In flood problems an inaccurate assumption of the value of $n$ results in an inaccurate determination of discharge; conversely, an inaccurate assumption of the value of $n$ results in inaccurate computation of backwater surface curves for known high-water discharges, which may cause embarrassment to a dam owner through expensive damage suits arising from higher backwater elevations than prophesied.

With the foregoing in mind, the writer became interested in developing a method of determining with sufficient practical accuracy both discharge and its corresponding value of $n$.

The method of procedure requires first a field survey of the stretch of river to be studied, to locate high-water marks and to develop a sufficient number of channel cross-sections. Information concerning high-water marks usually comes from local residents, and the data should include only definite marks noted by reliable observers. Under flood conditions rivers have a high velocity, and the water surface may have a turbulent appearance due to surges and standing waves; it is often difficult to determine accurately the flood stage at a given point, and two high-water marks only ¼ mile or so apart may not represent accurately the slope of the stream. As long a stretch of river as practicable should be studied —3 or 4 miles perhaps—so as to minimize the error in computing friction slopes. At least three high-water marks should be determined, appropriately spaced. A reasonable number of channel cross-sections should be developed and spaced fairly uniformly; results will be satisfactory as long as reasonable proportions are maintained—for example, more sections would be required for the smaller streams carrying lower flows, to obtain results with the same percentage of accuracy.

From the survey data a profile of the stretch of river may be plotted locating the position of high-water marks and channel cross-sections; the successive distances on the profile should be those effective under flood conditions and are not necessarily the same as the distances measured along the normal bank of the river. Channel cross-sections are then plotted, corresponding values of area and hydraulic radius computed, and curves drawn for each cross-section showing the variation of area and hydraulic radius with elevation.

In the Chezy formula $C$ is the coefficient of discharge for which the Kutter formula is

$$C = \frac{\dfrac{1.811}{n} + 41.66 + \dfrac{0.00281}{S}}{1 + \left(41.66 - \dfrac{0.00281}{S}\right)\dfrac{n}{\sqrt{R}}}$$

where $n$ is the coefficient of roughness of the channel, $S$ the friction slope and $R$ the hydraulic radius. By substituting the value of the average slope of the broken line connecting the high-water marks on the profile for $S$ in the Kutter formula, it reduces to a simpler form, and curves for $C$ may be plotted varying with $R$ for various values of $n$. Often flood slopes are high enough so that the effect of $S$ in the Kutter formula becomes negligible, and the formula may be written

$$C = \frac{\dfrac{1.811}{n} + 41.66}{1 + 41.66\,\dfrac{n}{\sqrt{R}}}$$

Flood slopes above 0.0005 have a negligible effect on $C$ so far as practical determination of discharge is concerned.

The final object of the computation is to determine the discharge that produces the surface curve passing through the known high-water marks. Friction slope does not coincide with surface slope unless the mean velocity remains constant from point to point along the river. The energy gradient is a line joining the energy head at all points of the channel; the energy head is the elevation of the water surface plus the velocity head at that point; the slope of the energy gradient represents all losses by friction, impact and eddies; only in special cases (some backwater problems) need any attempt be made to separate friction losses from ordinary eddy and impact losses; so usually the slope of the energy gradient is equivalent to $S$ in the Chezy formula. Curves may be drawn to show variation of velocity head with area of channel cross-section, for various values of discharge.

The next step is to determine trial values for the discharge and $n$ to correspond with the trial surface curve formed by the broken line joining the known high-water marks. Data pertaining to the available channel cross-sections are used to compute average values of cross-section area, hydraulic radius and wetted perimeter for each stretch of the river between two adjacent high-water marks; these average values depend on the surface elevation at each channel cross-section; some interpolation may be necessary when high-water marks do not coincide on the profile with the locations of the channel cross-sections.

The Chezy formula states that $Q = AC\sqrt{RS}$, where $Q$ is the discharge in second-feet and $A$ the cross-section area in square feet. For various assumed values of $Q$ an average value for $S$ is computed for each stretch of the river by considering the surface elevations indicated by the trial surface curve, the difference in velocity head corresponding to the assumed value of $Q$ and the distance between the high-water marks. The values of average $C$ are then determined by substituting the computed values for $A$, $R$ and $S$ in the above formula, and the corresponding values of $n$ obtained from the $C$-$R$-$n$ curves previously plotted. From inspection of the corresponding values of $Q$ and $n$, a reasonable value of $Q$ is selected for trial. The average values of $n$ corresponding to that trial $Q$ are then plotted against the average wet perimeter previously computed for each stretch of the river, and the curve so defined is used to determine the value of $n$ at each channel cross-section in turn. By definition $n$ is the channel co-efficient of roughness and may be considered to depend on the nature of the channel material and on the area of contact; the area of contact per unit length is wet perimeter or $A/R$, and what variation there is in channel material may quite satisfactorily be considered gradual and progressive.

Again using the Chezy formula, values for $S$ are computed for each cross-section, for various elevations, based on the trial discharge. Area and hydraulic radius are obtained from the curves of area and hydraulic radius previously plotted. The coefficient $C$ is obtained from the $C$-$R$-$n$ curves, the $n$ element now being taken from the curve showing variation of $n$ with wet perimeter. A curve is then drawn for each

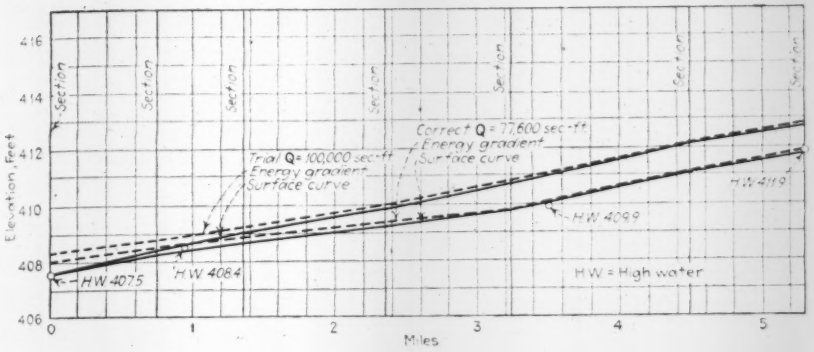



**FIG. 1—PROFILE** of water surface of river in flood, showing high-water marks and profile as computed from a trial discharge value.

cross-section, showing the variation of $S$ with water elevation.

Beginning at the first high-water mark, values necessary to determine water elevations are computed and tabulated section by section upstream for the trial discharge; it is advisable to carry the computation upstream with a sufficiently high trial $Q$, to avoid the complication that might otherwise result if the resulting trial surface curve as computed tends to cross the critical flow line. A form for the tabulation is presented in an article in *Engineering News-Record*, Oct. 1, 1925, p. 550, by J. C. Stevens, entitled "Computing Backwater Curves for Surface Slopes in Streams," and the details of computation are not reproduced here. The computed surface curve and energy gradient are plotted on the profile, and comparison is made with the required surface curve as determined by the high-water marks.

Fig. 1 shows a portion of the flood profile of a New England stream, indicating the high-water marks reached in November, 1927. The surface curve computed for a trial $Q$ of 100,000 sec.-ft. is shown plotted above the known high-water marks, showing that this trial $Q$ is too high. An assumed discharge, either too large or too small, would have a surface curve that would depart from the required surface curve regularly from the beginning, until the point of maximum difference in stage is reached when the assumed discharge is in equilibrium with stage and channel conditions, whence it would approximately parallel the required surface curve defined by the known high-water marks. The energy gradient is also plotted in Fig. 1 along with the surface curve.

Referring to Fig. 1, the maximum departure of the surface curve computed for a $Q$ of 100,000 sec.-ft. is 1.1 ft. above the high-water mark at mile 3.5. The computed rise in energy gradient from mile 0 to mile 3.5 is 2.77 ft.; the required rise in energy gradient so that the corresponding surface curve will pass through the high-water marks is $2.77 - 1.1 = 1.67$ ft.; and the correct value of $Q$ to correspond with the correct energy gradient and surface curve is $100{,}000 \times \frac{\sqrt{1.67}}{2.77} = 77{,}600$ sec.-ft., since $Q$ would vary as the square root of the slope, channel conditions remaining the same.

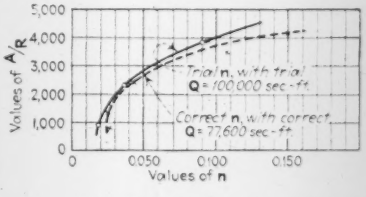



**FIG. 2—ROUGHNESS COEFFICIENT** plotted against wetted perimeter for trial value and corrected value of discharge as given in Fig. 1.

For a check, the detailed computation may be repeated using $Q = 77{,}600$ sec.-ft., first adjusting the slope curves to correspond with the new value of $Q$; this adjustment to the slope curves is made by applying a coefficient to the curves used for trial $Q$, this co-efficient being the ratio between the correct energy gradient and the trial energy gradient for each stretch between every two adjacent high-water marks and applied to all intermediate channel cross-section slope curves.

Usually only one trial computation is necessary, as the check computation produces a surface curve passing through, or within allowable practical limits of, the known high-water marks. Adjusting the slope curves to correspond with the correct value of $Q$, as above described, automatically adjusts all the interdependent functions upon which slope depends. At the end of the check computation the values of $C$ and $n$ may be computed for each channel cross-section and plotted against the corresponding value of wet perimeter, defining the curve shown in Fig. 2.

The example to which Figs. 1 and 2 relate is a New England stream that had a gaging-station record of the flood to which the computation by the foregoing method applies; the peak discharge of this stream at the location studied was reported by the U. S. Geological Survey as 78,000 c.f.s., practically the same as computed by the writer to test the accuracy of the foregoing method of computing river floodflows. This method was developed in 1931 and 1932 and was applied to the investigation of flood discharges of New England streams where no gaging-station records were available, while the writer was employed as associate hydro-electric engineer in the U. S. Engineer Office, Providence, R. I.

Generally, the stretch of river chosen for investigation is usually one with no tributaries of importance, so that it is reasonable to assume that the discharge remains practically constant throughout, and the item of channel storage will be offset by the runoff from hillsides and brooks. Sections and distances along the plotted profile should be representative of existing conditions; in the example upon which this discussion is based the width of the water surface averaged nearly $\frac{1}{4}$ mile for the lower half of the profile and $\frac{1}{2}$ mile for the remainder of the distance. The example chosen is intended to prove that the method of computation is applicable to a wide range of conditions, wide variation of $n$, etc., often found in backwater problems as well as in floodflow problems. Where the velocities run up to 10 or 15 feet per second and the river surface shows a turbulent and raging appearance, the surface curve often departs considerably at sections intermediate to the observed high-water marks from the series of straight lines joining those high-water marks. Joining the computed surface elevations at sections by straight lines produces a surface curve that is really somewhat approximate. An impracticable number of sections would be required to reproduce all the variations in the river's course.

The curve for $n$ in Fig. 2 represents conditions with a river out of its banks and overflowing the adjacent meadowland; a little experimentation shows the $n$ curve may be represented by a series of straight lines on logarithmic paper, which is a useful expedient helping to define a curve with only a few points representing computed averages. The value of $n$ appears to be a function of the circumstances, of which the least important is the nature of the material composing the channel. Identical computed values of $n$ are a matter of experience for various kinds of material forming river channels. Perhaps this is explained if one considers the main body of water to flow along in a channel lined with a more or less inert water cushion, the water near the shores and bottom being "slack water," speaking generally of rivers. Of all the circumstances contributing to the value of $n$, perhaps the area of contact, which is denoted by wet perimeter for a unit length, or $A/R$, is the function most readily calculable and useful as a measure of the variability of the value of $n$.

Backwater problems involving the calculation of water-surface elevations above a dam often depend for their solution upon an accurate interpretation of the value of $n$ representing conditions when much land adjacent to the normal river channel is flooded. Fig. 2 indicates that $n$ values may be much higher than those often assumed as representative; if too low values of $n$ are assumed, the computed water-surface elevations upstream are bound to be exceeded whenever the discharges used in the computations are actually experienced.

# Brick Lining Used for Irrigation Canal in Texas

**Lining of experimental 500-ft. section followed by more extended use indicates advantages of low cost, inexpensive equipment, minimum of skilled labor required and satisfactory hydraulic properties**

By W. I. Gilson
*Manager, Cameron County Water Control and Improvement District No. 6, Los Fresnos, Texas*

RESULTS obtained from lining with brick an experimental 500-ft. section of irrigation canal on the distribution system of Water Improvement District No. 6, Los Fresnos, Texas, led to installation of this type of lining for several canals and the accumulation of valuable cost data. Because the use of brick for the lining of irrigation ditches in the United States is very limited, it is believed that a brief description of the method used and the cost would be of interest.

Opportunity to construct the first experimental section resulted from the district securing a large number of usable brick at very nominal cost from a large storm-wrecked building. With this material available the writer secured permission from the directors of the district to use it to line a section of canal for securing information on cost and engineering features.

The preliminary engineering work required for this type of lining is identical with other lining operations except that the grade stakes are set 6 in. back from the outside edge of the lining. Following the setting of the grade stakes, there are three distinct operations, which may be referred to as rough trim, fine trim and lining.

## Trimming

The advantage of good hydraulic properties and ease in shaping led to the adoption of a semicircular section. A templet of this shape is first made with a diameter about 4 in. less than the finished canal. Across the top of this templet a board is attached with ends extending to rest on the grade stakes, and in this position the templet serves as a guide to the workmen making the rough excavation. It is the practice to leave about 0.2 ft. of soil for the final trimming operations.

A device developed by the local foreman has been very successful for the final shaping of the canal section. This consists of two pieces of 2x6-in. timber long enough to reach between the grade stakes. Between these two timber cross-pieces a length of pipe is attached (Fig. 1). The device is set up so that the pipe is on the center line of the canal section. Attached to this pipe, with a loose connection that permits it to revolve around the pipe, there is a hoe-like cutter of adjustable length. When this hoe is used to make the final trim, it cuts a perfect semicircle, leaving the canal ready for the placing of the lining.

FIG. 2—BRICK LAYING in the bottom courses is done dry with the mortar poured into the joints. The upper side courses are laid with a trowel.

The brick that has been used up to this time is of the usual dimensions. It is first thoroughly soaked in water and placed on the canal banks immediately before using so that it does not dry out. In the first experimental section all brick was laid with a trowel. It was discovered, however, that greater economy in labor could be secured by laying the bottom courses of brick with intervals between the units sufficient to accommodate the mortar, and then pouring the mortar

FIG. 1—FINE TRIMMING is done with a hoe-like device revolving on a pipe and cutting a semi-circular section.

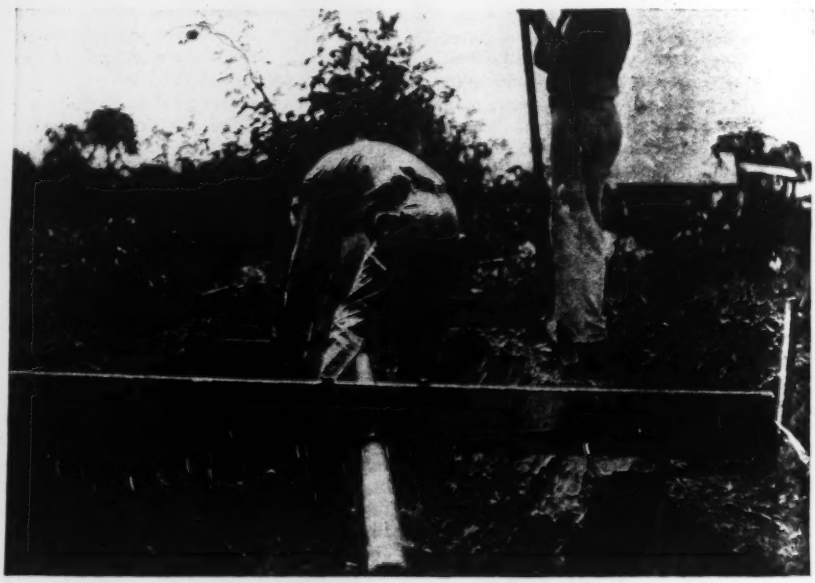


FIG. 3—SURFACE FINISH and observation of the flowing water indicate that the brick lining has satisfactory hydraulic properties.

on and sweeping it into the cracks. Mortar used for this purpose was somewhat thinner than that used for troweling.

### Lining procedure

The bottom courses are laid in advance of the side walls and can be seen behind the workman in Fig. 2. The courses of brick extending up the sides are then laid with a trowel to the top of the semicircular section. Any excess mortar is spread over the canal bottom with a trowel or broom. Following the completion of brick laying, a mixture of about one-half cement and one-half sand, mixed to a thin consistency, is applied with a brush to form a surface covering and improve watertightness. It has been the practice in the canals lined with this method to put water into the sections as soon as the mortar has set and then to sprinkle the part of the lining above the water line frequently for several days.

### Observations during use

Observations extending over a six-month period since the first canal was lined indicate that it meets all requirements of canal lining for this locality. Tests have not been made to determine the coefficient of friction, but appearance of finished surfaces and the flowing water (Fig. 3) indicate that it compares favorably with other classes of lining having concrete surfaces in contact with the water. The value of $n$ of .013 has been assumed in the design calculations. A scum forms on the submerged part of the canal lining in this locality, and some silt accumulates in the bottom of the canal so that the ultimate friction coefficient does not vary greatly from other types of lining.

During the construction of these several sections of brick-lined canal, cost data have been carefully kept. Mexican labor is available in the area where this work is done, and current wages vary from $1 to $1.50 per day, depending on experience and the length of service of the individual. An American foreman is employed at current wages for this class of work. The cost of the brick is $5 per M. delivered, and the cost of sand is $3 per yard on the job.

Items of cost per square foot of lined canal are as follows:

| | Per Sq.Ft. |
|---|---|
| Brick | $.0182 |
| Cement | .0125 |
| Sand | .006 |
| Common labor | .0185 |
| Supervision | .0062 |
| Truck and miscellaneous | .0075 |
| Estimated cost of rough trim by CWA | .0100 |
| Total cost | $.0789 |

It is probable that the cost of supervision could be reduced by using larger crews.

When the present supply of brick is exhausted, it is the intention of the district to conduct experiments with brick of other dimensions, and it seems probable that the cost of the mortar per square foot can be reduced.

### Conclusions

1. The cost data indicate that the cost per square foot for this lining is less than for most types of concrete linings.

2. No equipment is required for this lining installation other than simple devices which any intelligent foreman can make.

3. Skilled labor is not required beyond that normally found in crews that do repair and construction work on canal systems.

4. The equipment for final shaping can be adjusted to form any size of canal required. Any templets required can be easily constructed of wood.

5. Observations to date indicate that there is less cracking resulting from setting and temperature changes than in some forms of concrete lining.

6. The semicircular section provides desirable hydraulic characteristics.

# Direct Method for Laying Off an Angle in the Field by Repetition

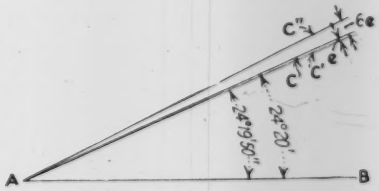
By Robert E. Gohl
*Jamestown, Pa.*

A METHOD for laying off an angle with a transit by using repetition to secure a high degree of accuracy may be of interest because of the frequent occurrence of this problem. This is a direct method for field use and requires practically no computation work.

Assume that the problem is to lay off a line $AC$ (see accompanying figure) making an angle of 24 deg. 20 min. with the line $AB$. With the transit set at $A$ and the vernier set at zero degrees, sight the telescope at $B$. Lay off the line $AC'$ as carefully as possible within the limits of the particular instrument. The angle $BAC'$ as laid off usually will be in slight error with the desired angle. Assume that the angle actually laid off with the single reading is 24 deg. 19 min. 50 sec.

After laying off the line $AC'$, leave the plates of the transit clamped together, loosen the lower clamp and turn back to point $B$. Set the telescope on this point with the lower clamp and tangent screw. Then loosen the upper clamp and sight on the point $C'$, which has been set, using the upper clamp and its tangent screw, thus adding another angle equal to the first one on the reading on the circle.

Repeat this operation until, for example, the angle $BAC'$ has been added six times. On the last repetition, in this case the sixth, instead of setting the telescope on $C'$, set the vernier on six times the desired angle, or exactly 146 deg., and place the new point $C'''$ on the line of sight. As a result of this process the distance between $C'$ and $C'''$ represents six times the error made in placing the original point $C'$. To get the correct line, place point $C$ one-sixth of the distance from $C'$ to $C'''$.




REPETITIONS permit laying off accurate angle in the field.

Any number of repetitions may be used. In the last repetition set the vernier for the reading that it would have if the first angle had been turned precisely—i.e., the number of repetitions times the correct angle. The correct point then lies between the first and last points set, and its distance from the first point will be a fraction, the reciprocal of the number of repetitions, of the distance between the first two points.

# Steel Bridge Awarded Prize Is of Three-Hinged Tied-Arch Type

AWARDED first prize as the most beautiful steel bridge costing less than $250,000 that was erected last year, the Dr. John McLoughlin Bridge over the Clackamas River in Oregon is also notable technically. The design—three-hinged tied-arch—is rare if not unique. The lateral components of the thrust of the steel box-girder arches are taken by eyebar ties that are completely articulated and pass through holes cut in the webs of the floor beams. The son Bay Co. representative. It consists of a central arch span of 240 ft., flanked on either side by similar spans of 140 ft. The total length of the structure, including approaches, is 720 ft. The roadway is 48 ft. wide, and there are two 5-ft. sidewalks. Foundations are on piles.

A closed box-girder section (50 in. deep and 34 in. wide on the center span) is used for the ribs, which have a rise of 50 ft. in the center span and 34 ft. in the side spans. The ties consist of 8x appearance, this type of design affords a relatively unobstructed view from the roadway, an advantageous feature in localities where scenic considerations are important. There is also said to be a slight economy in first cost over simple through-truss spans by virtue of a saving in metal, the comparative weights being 1,788,000, and 1,813,000 lb. for designs of equivalent roadway and span dimensions. The pound price for steel fabricated and erected was 5.3c.. one of the lowest prices received in the locality for many years. The total cost of the bridge was $161,570.

The bridge was built by the Oregon state highway department, the contractor being Poole & McGonigle, Portland, Ore. The structure was designed and

FIG. 1—FIRST PRIZE for steel bridges costing less than $250,000 was awarded to the Dr. John McLoughlin Bridge in Oregon.

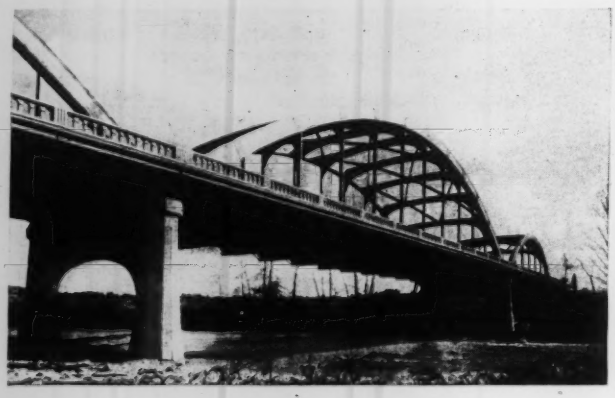
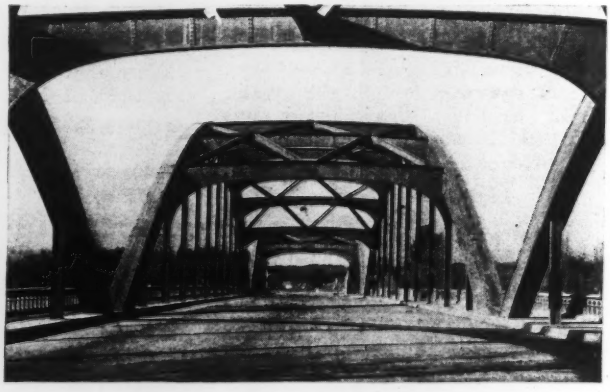


FIG. 2—ROADWAY PORTAL, showing curved treatment. Note the radial swaybracing used.



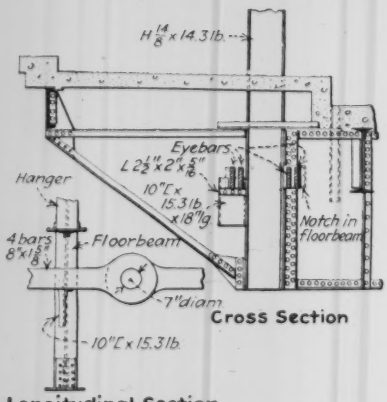



FIG. 3—DETAIL at the junction of the eyebar arch ties and the floor system for the 240-ft. arch.

pins are placed off-center from the panel points so that the arch ties are entirely separate from the floor system and hangers. This arrangement was adopted to free the ties from secondary stresses and to avoid any uncertainty in stress distribution, and is believed to be a new detail.

The bridge was named in honor of an early pioneer of Oregon and a Hud- 1⅞-in. eyebars, two being used for each short-span rib and four for each long-span rib (Fig. 3). Pins are 7 in. in diameter in the 140-ft. spans and 9 in. in diameter in the 240-ft. span. The floor is suspended by H-section hangers.

In addition to presenting a pleasing construction supervised under the direction of C. B. McCullough, assistant state highway engineer. O. A. Chase was chief designing engineer, G. S. Paxson assistant bridge engineer in general charge of construction, and Marshall Dresser resident engineer.

## Code Unites Douglas Fir Loggers of Northwest in Strict Fire-Control Plan

LOGGING OPERATIONS in the Douglas fir areas of the Pacific Northwest now are carried on under the recently adopted rules for conservation and protection of fir forests under the NRA code for the lumber industry. The code requires each branch of the industry to develop and adopt its own plan of operations under schedule C, the section on conservation and protection; and because of the great fire risks in the fir districts the rules for this division were made exceptionally comprehensive and exacting. The rules were adopted after a series or hearings and discussions in numerous cities of western Washington and Oregon. These were intended to bring to a focus the best thinking of officials of the U. S. Forest Service, the forest fire associations of Oregon and Washington, forestry departments of the two states and logging operators. There are about 800 firms engaged in woods operations in the Douglas fir districts whose cut in the first half of 1934 was at a rate that would make the total cut for the year about five million bd.-ft. In one sense the code is a test of whether these operators can succeed in a policing matter, essentially a problem of self-government.

The rules provide for instruction in fire prevention and organization for fire fighting. Patrols are to be maintained and fire warnings given.

There is also a list of miscellaneous fire risks to be guarded against, such as friction between moving steel cables; definite requirements are set up as to hazards that must be removed before leaving a logging operation, such as the felling of snags which might spread fire by burning and falling.

# *Letters to the Editor*

## The Institute and the Code

Sir—The news item entitled "Code Opposed by Institute of Consulting Engineers," appearing on p. 154 of your issue of Aug. 2, refers to the Institute's action as a change of view on the part of the Institute in regard to the code. Such a statement is typical of the confusion which is so apparent among engineers in regard to the code, and it seems to me to arise from attempting to deal at one stroke with two distinct questions. The first, whether any code should be imposed on the engineering profession; and the second, if a code were to be imposed, should such a code be that prepared by the Am. Soc. C. E. committee or some other?

The officers and council of the Institute have been consistently opposed to the principle of subjecting the work of professional engineers to the jurisdiction of a code authority. The question that arose a year ago was not as to the principle of a code, because at that time emphatic representations were made to the council of the Institute that a code for engineers was unavoidable. The sole question involved was as to whether the code would be dictated by professional or commercial interests. The Institute, therefore, irrespective of its objections to the general principle involved, considered itself under obligation to the profession and to the public to join with the Am. Soc. C. E. engineers' code committee in its efforts to secure the best possible code.

During the intervening period the attempt to formulate an engineers' code has demonstrated the practical impossibility of defining the scope of construction engineering activities with sufficient accuracy to determine what engineering services pertain to construction and what do not, and it has accentuated the disadvantages of operation under a code.

Recent developments in connection with other code authorities and particularly the announcement of the President on May 27, 1934, eliminating service industries from the jurisdiction of code authorities, have so changed the situation as to encourage a belief that professional engineers might be able to secure an amendment to the construction industry code which would entirely eliminate their activities from its jurisdiction. It was with this possibility in mind that the council of the Institute conducted the recent canvass of its membership, with the results that have been reported.

The present action of the Institute in moving for an amendment to the construction industry code should not be considered as in any way reflecting criticism on the work of the engineers' code committee, the members of which have given their energy and time conscientiously and unselfishly to the formulation of a code of fair practice, which, on the assumption that a code for engineers is unavoidable, would best protect the public and the engineering profession.

GEO. W. BURPEE,
President American Institute of Consulting Engineers.

New York, N. Y., Aug. 9, 1934.

IT IS OBVIOUS that confusion as to the position of the American Institute of Consulting Engineers in regard to the engineers' code might arise from any brief factual statement regarding its action of July 17 because the Institute's endorsement of the original draft of the code was a qualified endorsement; as indicated by Mr. Burpee. Other organizations, including the American Society of Civil Engineers, went into the code work with similarly qualified views. All went into the code work with misgivings as to the need of a code for engineers, as stated in our editorial comment on this subject in the issue of Aug. 9, p. 186. As in the case of the Institute, any change of position in regard to the code on the part of these other organizations will be a change in the *formal position*, not the actual position of the organization in regard to the engineers' code.
—EDITOR.

## Checking Rigid-Frame Analysis

Sir—In their article on "Checking Moment Computations for Rigid Frames" (*ENR*, July 26, 1934, p. 112), Messrs. Niles, Vernier and Campbell have answered a question that has probably worried many persons entering upon a study of the Cross method of moment distribution—that is, how may one check the results of his calculations? The same problem arises in determining the accuracy of the moments obtained by the writer's simplified method of wind-stress analysis referred to by the authors.

The first check available is furnished by the equation $\Sigma M = 0$ for the final moments around a joint. Numerical errors in balancing joint moments will be detected by the fact that one or more joints will not be in equilibrium. If such an error is found, it may be eliminated by the introduction of a correction moment, which is then treated as a fixed-end moment to be balanced in the usual manner. Unfortunately, however, an error such as failure to carry over a column or girder moment will not be detected from the equation $\Sigma M = 0$. Neither can such errors be found from the equation $\Sigma H = 0$, since one adjusts shears by proportion in the simplified method, to make them check with statics.

To locate errors such as these, one is forced to study the geometry of the deflected structure or else to investigate the requirements of continuity at the joints in terms of relative end rotations of members rigidly connected. One can easily show from area moments that the changes in the moments at a joint caused by rotation of any number of joints are proportional to the $KV$ values of the members meeting at the joint in question

where $K = I/L$ and $V = \dfrac{1}{1 - \frac{1}{2}\frac{M_B}{M_A}}$,

$M_B$ referring to the moment at the far end of the member. By the use of this relationship, one can check the relative values of end moments introduced by the balancing process, noting that $M_A$ and $M_B$ are changes in end moments and not final moments. This simple formula applies only when members are of uniform section. For an extension to haunched beams one should consult the text on continuous frames of reinforced concrete by Cross and Morgan. This check is not applicable when joints are allowed to translate.

When applying the simplified method of wind-stress analysis, one should find the check mentioned above to be adequate, since the procedure for handling joint translation amounts to a simple proportion where there can be little possibility of error. However, if one desires to check final moments, he must investigate the geometry of the deflected structure to assure himself that it agrees with the requirements of continuity and common sense. Probably the procedure indicated by the authors is as satisfactory as any. The writer has in one particular case (see *Proceedings*, Am. Soc. C. E., January, 1934, p. 96) located a serious error in an analysis by plotting the column deflections of a wind bent as computed from the final moments. Since the girders do not change in length appreciably, continuity requires that the deflected columns shall have nearly the same shape. If one computes such deflections by use of the conjugate beam theory, joint rotations will also be obtained.

In completing his comments upon the author's method, the writer would like to note that there is an advantage, particularly to the student, in carrying the check on $\theta$ and $R$ values to the ultimate objective of actually drawing the deflected structure. A visualization of the physical action of the structure is so highly important that one should take full advantage of every opportunity to extend what has been termed his "structural sense" in regard to such matters.

L. E. GRINTER,
Professor of Structural Engineering, Texas Agricultural and Mechanical College.

College Station, Texas, Aug. 1, 1934.

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Aug. 23, 1934


## *New Treaty Needed*

THE RECENT ROCK FALL at Niagara, while only remotely related to the conditions that were to be corrected by the remedial works contemplated in the treaty rejected by the U. S. Senate in 1931, serves nevertheless to draw attention to the ever-increasing need for redistribution of the flow over the falls if they are to be preserved as a magnificent spectacle. The present rock fall occurred on the Goat Island side of the Horseshoe Falls, where recession of the crest due to erosion at the base of the cliff is presumably least rapid. That section of the cliff ultimately will be laid bare if the rapid cutting away of the center of the horseshoe where the greater part of the flow now plunges into the gorge is not checked by diversion of part of the flow to the side of the horseshoe. The submerged weirs and excavation covered by the proposed treaty of 1929 are as desirable a means of redistributing the flow as could be devised. The trouble with that treaty was that it proposed to let the power interests build the works in return for an added diversion of water. The United States Senate rightly refused thus to tie the construction of remedial works to power development. But now that both countries are looking for desirable public-works projects a new treaty might be drawn calling for construction of the remedial works with public funds. After they are completed, the matter of added power diversion can be taken up as a separate question.

## *Wage Schedule Troubles*

IN CONNECTION with the present stability of construction which we pointed out in this column last week, a potential element of disturbance needs to be considered. Intermediate wage scales for public-works construction are becoming a troublesome question. Nearly a year ago the PWA established zone rates of minimum pay for skilled and unskilled construction labor, but it did not set up a classification of intermediate crafts, the so-called semi-skilled crafts. Nor has it done so since then. Still less has it prescribed a minimum wage scale for these crafts. Important contracts are being held up awaiting an official ruling on such classification and scale, and on whether these may be inserted in the call for bids. That the government has avoided all commitment in this matter is an unforunate illustration of the squeamishness with which it handles labor questions. Construction is certain to be under a handicap as long as there is no dependable basis for cost calculations; loans and bond issues cannot be decided upon, construction cannot be planned, bidding and contracting lack a secure foundation, and credit cannot be measured. The present practice of deferring the settlement of labor questions (whether on wages, jurisdiction or classification) until after the issue is harmful to all. A definite labor classification is the first step toward correcting this condition; setting minimum rates for each class and prescribing these rates in every public call for bids is the next. The Construction Planning and Adjustment Board set up by the code could do a public service by speeding such action on the part of the government.

## *Are Roads Subsidized?*

SINCE FEDERAL AID for highways began in 1917 the federal government has contributed in round figures about $2,000,000,000 to road construction. This total includes the $800,000,000 in emergency grants to relieve unemployment, the last of which will not be paid out for labor and materials until some time in 1935. In the fiscal year just ended the motor car owners of the United States paid $309,000,000 in federal taxes, of which about one-third were imposts other than the tax on gasoline. And last year these same car owners also paid the states in local and state taxes somewhat over $932,000,000. A liberal estimate of road construction in 1934 is $650,000,000 and an equally liberal estimate of road maintenance is $200,000,000. The most skilled juggling of figures will disclose to the motor car owner no other conclusion than that for $800,000,000 of road work in 1934 he will have paid in taxes about $1,200,000,000. Accepting this disposal of his tax-money as wholly justifiable, the motor vehicle owner is plainly cleared of the charge that he is benefiting from a government subsidy for which he is making inadequate tax payments.

## *Emergency Undertaking*

ONE OF THE constructive accomplishments of the recovery campaign is its contribution toward hastening completion of the map of the United States. Many of the current emergency activities depend on correct maps and are delayed and hampered where such maps are not available. Even more important is the need of complete and accurate maps, especially those with full topographic detail, in normal-time planning and construction. Continuation of the emergency surveying program at a rate sufficient for early completion of the map will therefore contribute something of permanent value. On the other hand, if the work is now discontinued there is little prospect of realizing the hope that the map may be completed within a few years instead of the three or four generations that otherwise seems probable. Engineering organizations have long been active in efforts to speed up the survey program, but after they had induced Congress to authorize such speeding-up the authorization remained ineffective because funds to carry it into effect were not appropriated. Precisely the same disappointing result may be looked for in future unless the present emergency is utilized to push the work ahead for early completion. That it is an excellent type of relief work has been demonstrated; that it creates an asset greatly needed as a preparation for activities of the early future is equally certain. On these grounds it deserves a place of early priority in the list of recovery undertakings.

## *Add to the Records*

BRIDGE HISTORY continues to be recorded in the steady advance of the San Francisco-Oakland project. Substructure work is nearing completion and has brought out several innovations which are definite contributions to the art of deep foundation sinking. First there were the unique domed caissons used so effectively in the West Channel, and now the work in the East Channel

has added the feat of sinking a caisson by open dredging to the record foundation depth of 240 ft. and the development of a sheetpile cofferdam design which goes far toward eliminating the serious difficulties encountered in the use of interior bracing. It is fitting that the names of two deans of the art—Daniel E. Moran and E. H. Connor—should be associated with this project. As long as foundation problems receive the same originality and thoroughness of treatment as those of the San Francisco Bay crossing the art will continue in healthy growth.

### *Better Communication*

COMPLETION and inauguration of the ambitious Mersey Tunnel undertaking is a reminder of the continuing pressure for improved transportation facilities. Like the numerous large bridge enterprises of the past decade and today, most notable of which at the moment are the two great San Francisco bridges and the Tri-Borough Bridge at New York, the Mersey Tunnel reflects the contribution made by engineering progress toward overcoming ancient obstacles to traffic flow. Two or three decades ago its construction would have been too difficult to attempt; new engineering resourcefulness made it practicable. But apart from the methods used and the great magnitude of the work, the tunnel is noteworthy for its cost, which is roughly comparable with that of the Holland Tunnel under the Hudson River at New York. The traffic conditions of past generations would not have justified so great an investment, but since the pressure of traffic is still growing, it is logical to conclude that many further transportation improvements of major size will be built in the near future

# Continued Recovery—A Problem for Engineers

SOME significant facts of the times call for present thought as matters that bear intimately on the general welfare. They emphasize the shortcomings of present recovery measures and point to the need for a new and vigorously prosecuted attack on the problem of recovery if the present rate of advance is to be surely maintained.

Foremost of these facts is the disquietingly large volume of unemployment that still remains—more than ten million workers according to the consistent and always realistic figures of the American Federation of Labor. Next is the small reemployment effect of the recovery measures so far applied. Third is the slow rate at which spontaneous revival contributes to reemployment and the slight promise of the measures now in operation. Fourth is the accumulated evidence that temporizing methods of dealing with unemployment are in the long run valueless and that charity or dole relief has proved to be a failure.

The CCC, the CWA and the state relief-work activities have in turn demonstrated their uselessness as recovery agencies. Dispensing pauper allowances under the thin veneer of a work system removed from the currents of industry and business, they represent public philanthropy alone. Such influence as they had on recovery was usually harmful, as where relief workers displaced regular employees in maintaining public services, or where needed public buildings that should have provided regular jobs for craftsmen were built by CWA men. The failure of the direct-relief-payment system is even more thoroughly recognized.

The present situation should be understood clearly. Tardily, but now quite generally, it has come to be recognized that unemployment is the key problem of economic depression. Accordingly, after the hastily established CWA system had carried through last winter and its activities had been brought to a close early in the spring, the hope of the country was that reviving industry would reemploy not only the men then released but additional millions, progressively restoring economic normality. This hope was disappointed by the summer's events. In fact, ground was lost, as in the case of the shipping strike, which, favored by absent treatment, caused a loss of income to the Pacific Coast greater than all the money being poured into that region in the government's four-year campaign of federal projects. Thus, with no progress made since spring, it is altogether likely that the coming winter will see an unemployment problem more severe than last year's, with an inevitable reaction on recovery.

In projecting this record forward, allowance must be made for the developments of the coming months. A business revival is ahead of us; this may reemploy a few hundred thousand workers. The government is carrying on a repair and modernization drive; if fully successful, it may put some additional hundred thousands to work. The joint effect of these influences however, will be of little weight when compared to the number of unemployed and the burden of wasted productive power.

Of the whole series of deliberate employment and recovery measures hitherto used only the PWA has proved its effectiveness. Relief measures, already mentioned, have been sterile in respect to recovery. The industry-code system of the NRA, after accomplishing some redistribution of employment and wages but probably adding little to the total, now appears to be creating chiefly strike idleness; at best its influence on the present volume of unemployment is remote, and it cannot be looked to for aid in the present juncture. But public-works stimulation through the PWA did introduce new and constructive activity, put men to work and reactivated commerce and manufacture. True, it moved too slowly to meet the requirements of the emergency or the intent of its legislative sponsors; yet it represents the only recovery agency that directly attacked mass unemployment.

What form the new system shall take remains to be worked out. Without doubt it must be founded on the PWA principle of meeting real present needs by the application of normal planning and contracting procedure. It must not be allowed to degenerate into barren relief work or dissipate its effect in fanciful undertakings. Just as clearly, however, it must avoid the procrastination and red tape of the PWA and approach the speed and directness of last winter's CWA campaign.

The question of what method can meet this requirement is commended to those engineers and officials who labored with the CWA forces and with the thousands of PWA problems of the past year. Their experience and ingenuity can point the way to the solution.

# CURRENT NEWS

## Bonds Held by PWA Sold at Premium By the RFC

NINE blocks of state and municipal bonds held by the PWA were sold at a substantial premium by the RFC on Aug. 21. Two issues of railroad securities, also offered for sale by the RFC, brought bids somewhat under par and only one of the issues was sold.

The nine blocks of bonds aggregate about $3,500,000 and, with one exception, carry coupon rates of 4 per cent. One issue, that of the Richmond County, Ga., school bonds, carries a rate of 4½ per cent. The prices paid brought the yields on the bonds down to as low as 2.1 per cent in one instance.

**List of bonds sold**

The issues offered for sale and the prices received by the RFC were as follows:

Schenectady County, N. Y., $160,000 county home bonds, $1,074 per thousand.

Lynchburg, Va., $160,000 water bonds, $1,060.50 per thousand.

Buffalo, N. Y., $300,370 general improvement bonds, $1,042.60 per thousand.

Hamilton, Ohio, $326,000 waterworks bonds, $1,030.60 per thousand.

Littleton, N. H., $118,000 general obligation bonds, $1,038.97 per thousand.

Bristol, R. I., $100,000 sewer bonds, $1,037.50 per thousand.

Richmond County, Ga., $250,000 school bonds, $1,066.40 per thousand.

Maryland State Roads Commission, $930,000 bonds, $1,023.046 per thousand.

Montana highway debentures, $1,140,000, $1,011.75 per thousand.

In addition to the state and municipal bonds, an offering of $1,204,000 Lehigh and New England Railroad Co. equipment trust certificates was sold at $970.11 per thousand. As these certificates do not begin to bear interest until next year, the yield is slightly less than 4 per cent. An offering of $1,200,000 equipment trust certificates of the C&O Railway Co., for which $997.50 per thousand was bid, were not sold.

The offering was the first step in the program recently announced by the RFC to offer PWA holdings for sale as a means of creating a revolving fund for the PWA. Authorization has been given the RFC to buy up to $250,000,000 of the securities taken by the PWA as collateral for construction loans. The $250,000,000 limit refers to the amount of RFC funds that can be tied up at any one time.

## PWA Allots $24,540,250 To 215 Non-Federal Projects

Allotments totalling $24,540,250 to finance 215 non-federal PWA projects have been announced by Administrator Ickes. With these allocations the grand total of non-federal projects to be financed by the PWA is 4,028. Many of the new allotments are to communities in the drought-stricken areas of the Middle West.

## Administrator Ickes Visits Site of Passamaquoddy Project

*Washington Correspondence*

PWA Administrator Ickes' trip to Eastport, Maine, this week, to view personally the site of the Passamaquoddy tidal power project aroused great interest as the PWA Board of Review reported last May that from an economic standpoint the time had not yet arrived for development of the project. The Board recommended that the application of Dexter P. Cooper, Inc., for a loan of $47,000,000 be disapproved but the Board of Public Works has not taken final action to date.

The sponsors of the project have been actively seeking favorable consideration of their plans for construction of a tidal power plant, equalizing plant and plants to make aluminium and stainless steel. Hugh Cooper, brother of Dexter P. Cooper, has spent much time in Washington recently.

The Passamaquoddy Bay region has long been recognized as one of the few localities in the world where extremely high tides, coupled with favorable topographic conditions, offer an opportunity for large tidal power development.

The Board of Review reported that the cost of Quoddy power as compared with the cost of power from undeveloped rivers in Maine, or steam power from the New England seaboard would be unfavorable to Quoddy, the market for such a large block of additional power does not exist and the advantage of operating aluminum and stainless steel plants at Eastport as compared to other localities, had not been demonstrated. The project had previously been disapproved by the Federal Power Commission.

Rumors indicate that the trip of the administrator may have had political inspiration coming just prior to the Maine election.

## Suits for $14,000,000 Filed on Alleged Boeuf Floodway Damage

Suits against the United States totaling more than $14,000,000 have been filed, alleging damages resulting from the act of 1928 creating the Boeuf Basin floodway channel for flood flows of the Mississippi river through Chicot Desha and Ashley counties, Ark. The suits have been filed in the court of claims at Washington, D. C., and also in the federal court at Little Rock and Helena, Ark. In addition to suits of individuals for alleged damage, there is a claim of $3,000,000 by the Southeast Arkansas Levee District, a suit of $2,500,000 by the Cypress Creek Drainage District, and one for $2,525,000 by the Eudora-Western Drainage District.

The receivers for the drainage and levee districts allege that the creation of the floodway will destroy the value of the improvements created by the districts. Damages are requested to pay for outstanding bonds and for damages to the acres owned by the districts.

Fifteen individual suits reported to be filed at Washington exceed $10,000 each.

## Wage Disputes Cause Delay and Problems of Higher Costs on Reclamation Projects

Washington Correspondence

LACK of a definite policy on wage rates is tending to cause delays on several important projects of the Bureau of Reclamation. PWA requirements apply, with an exception permitting 40 instead of 30 hours work a week, but these rates are only the minima for two broad classifications, common and skilled, and intermediate grades of labor are not mentioned. Rates demanded by union labor on projects of the Bureau of Reclamation probably would increase the labor cost one-third. This would result in a greater outlay by PWA, as original estimates were based on rates customarily paid by the Bureau, and consequent increased risk in collecting from the irrigators.

Because jurisdiction in any conflict regarding wage rates rests with the PWA Labor Board of Review, a proposal that specific wage rates be written into all advertisements for bids has not been favorably regarded by Administrator Ickes, with the result that the letting of contracts or advertisement for bids has been held up on the Grand Coulee power dam on the Columbia River, the huge Casper-Alcova irrigation project on the North Platte, and additional construction work on the Owyhee project in Oregon-Idaho, Milk River project in Montana, Ogden River work in Utah and Uncompahgre project improvements in Colorado.

Comparatively high wage rates paid on the Bonneville navigation and power project on the Columbia River, being built under the direction of the Corps of Engineers is the immediate cause of dispute regarding rates on the projects of the Bureau of Reclamation. Because the Grand Coulee development is also for power, labor contends that the farmers' ability to pay is not a limiting factor.

In an attempt to straighten out this complication at Grand Coulee, on which the rates that the contractor proposes to pay are lower in general than the Bonneville scale, the PWA Labor Board of Review visited Spokane a month ago. Their only recommendation appears to be the appointment of a special board to handle the case.

Created by President Roosevelt, prior to his departure for Hawaii, to reconcile any conflicts of jurisdiction or policy among New Deal agencies, the Emergency Industrial Committee, which includes Donald Richberg, Secretary Perkins and General Johnson, has attacked the wage question which has caused delay in reclamation work at a time when activity would raise morale in the drought territory.

## Advisory Committee Named for American Standards Association

Nine prominent industrial leaders have been named to membership on the Advisory Committee of the American Standards Association. Members of the committee are: Chairman George B. Cortelyou, president, Consolidated Gas Co.; Sewell L. Avery, chairman of the board, Montgomery Ward & Company; Lammot duPont, president, E. I. duPont de Nemours & Co.; Walter S. Gifford, president, American Telephone & Telegraph Co.; Henry I. Harriman, president, Chamber of Commerce of U.S.A.; W. A. Irvin, president, U. S. Steel Corp.; James H. McGraw, chairman of the board, McGraw-Hill Publishing Co.; Gerard Swope, president, General Electric Co.; Daniel Willard, president, Baltimore & Ohio Railroad.

"As industry becomes increasingly complex and ramified," Howard Coonley, president of the association, stated, "we must depend more and more upon the coordinating functions of standards. The standardization movement is today one of the most important integrating agencies in the country. It offers a democratic, widely representative forum to which come manufacturers, distributors and consumers to work out together their problems without governmental supervision.

"This group of nationally recognized leaders, who will serve on our advisory committee, have known the value of standards in their individual industries. They now indorse the wider phase of this work, namely, the inter-industry functions of national, or American, standards."

## Court Approves Incorporation of St. Louis Sewer District

Court approval has been given to the incorporation of the St. Louis County Sanitary Sewer District, and the county board of election is instructed to arrange for a bond election to provide financing for the $5,878,000 project, which will include 120 miles of trunk sewers to serve about 80 square miles of territory. A PWA grant will provide $1,361,000 and the balance of the cost of the work will be supplied by the bond issue.

At the bond election three trustees will be elected to supervise the carrying out of the project. The salaries of these trustees will be $25 a month, the compensation of the district's attorney is fixed at $250 and the salary of the engineer for the district must not exceed the salary paid the county highway engineer, which is $600 a month.

Judge Mueller, of the circuit court, in approving the countywide sewer project rejected the application of citizens of the town of Clayton requesting that they be permitted to organize a separate sewer district which would have included a $226,000 project. The court decided that in its opinion the broad general plan was better. Clayton residents contended that their proportion of the general district program would have been $357,350.

Attorneys for the Clayton district and other opponents of the county sewer development program have announced they will demand a rehearing and, if necessary, take the case to the state supreme court.

The election for the bond issue must be held within 60 days and a two-thirds majority is required.

# Construction Code Authority Holds Meeting at Chicago

A RESOLUTION protesting the Executive Order authorizing a 15 per cent reduction in bids on construction materials sold to governmental agencies and the initiating of an educational program to explain the code and its operation to the industry, featured the meeting of the Construction Code Authority at Chicago, Aug. 17. The meetings included sessions of the executive committee and finance committee of the authority, the Area Agreements and Jurisdictional Disputes committees of the Planning and Adjustment Board as well as a meeting of the full board, and of the Construction League Policy Committee.

The code authority adopted a resolution protesting the so-called "15 Per Cent" Executive Order which permits members of groups which have open price systems to bid not to exceed 15 per cent below filed prices for furnishing materials or other services to governmental agencies. The resolution, which is to be transmitted to President Roosevelt, states, in effect, that inasmuch as it makes possible the purchase of construction materials by the government and other agencies at substantially 15 per cent less than the market price which contractors have to pay, this order had the effect of checking private enterprise and it requests that the Executive Order be either recalled or extended to include all members of the construction industry.

The code authority initiated the establishment of a committee to report on further coordination of the field agencies of the various divisional code authorities in accordance with a request from NRA for a study of this situation.

An extensive educational program on the construction code, which was approved by the code authority at its meeting last week, was started at the Chicago meeting, when members of the authority, NRA officials and representatives of several temporary coordinating committees, discussed various phases of code administration. This is the first of a nationwide series of meetings with members of the 53 coordinating committees and the industry.

The National Construction Planning and Adjustment Board held its second meeting in Chicago, Aug. 16. Announcement was made of the appointment of T. T. Flagler, general contractor, Atlanta, Ga., as a member of the board to fill the position left vacant by the resignation of L. J. Horowitz. The board established standing committees, including an executive committee empowered to carry on the business of the board between its quarterly meetings. Its committee, previously named to study jurisdictional disputes and to report a plan to answer the President's request when he signed the construction code, stated its findings to the board.

Stephen F. Voorhees, chairman of the authority, spoke of the progress of the industry under the code. He stated that the industry had just passed through one important phase of the code—national unification and the creating of divisional administrative bodies. He indicated that the next step would be the unification and coordination of all groups, and that while the various authorities would retain the administrative leadership of the various divisions, additional responsibility for code compliance would undoubtedly be placed upon local organizations.

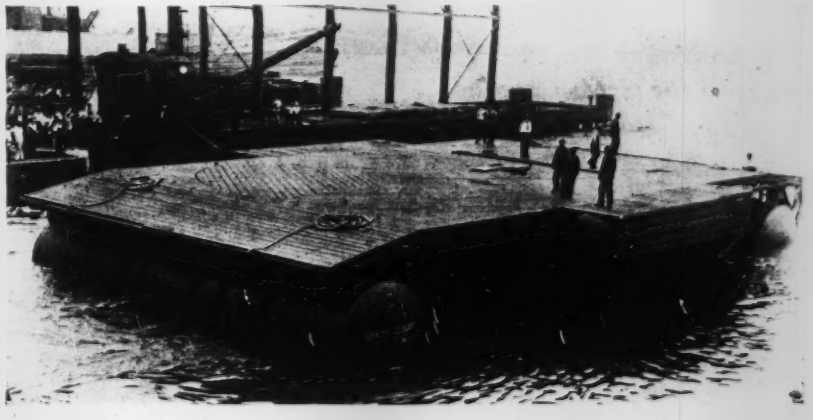
Other addresses were made by Sullivan W. Jones, chairman of the Planning and Adjustment Board, NRA Deputy Administrator Robert N. Campbell, M. J. McDonough, president of the building trades department of the American Federation of Labor and Oscar W. Rosenthal, president of the Builders Association of Chicago.

### RAMP FOR SEAPLANES BRINGING COMMUTERS TO WALL ST.

**After launching at the Brooklyn Navy Yard, where it was built by relief labor for the New York Department of Docks, this seaplane ramp was towed to the foot of Wall St. where it will be put in service for air commuters on Aug. 28. A similar ramp, now under construction, will be located at the foot of 31st St. and the East River.**

**These two ramps, 89x56 ft. in area, are covered by wood decks resting upon five lines of steel trusses, 9 ft. deep, supported by cylindrical steel buoyancy tanks about 12 ft. in diameter. In the deck is incorporated a 45-ft. diam. power-driven turntable by which the seaplanes can be revolved. The lower end of a ramp can be raised or depressed by mechanical control of pneumatic pressure in two buoyancy chambers of the outboard tank.**

**At the foot of Wall St. a waiting room and office building in the form of a white cottage surrounded by a picket fence and flower beds is under construction.**



# St. Lawrence River Bridge Allotted $2,800,000 by PWA

AN ALLOTMENT of $2,800,000 has been made by the PWA to the St. Lawrence Bridge Commission for the construction of a high level vehicular toll bridge across the river between Ogdensburg, N. Y., and Prescott, Ont. The loan and grant is being made on condition that the commission provide $1,200,000 toward the cost of the project, to be secured by a second lien on the operating revenues.

The funds provided by the PWA will be spent for labor and materials and the project is estimated to provide direct employment for 300 men for a two-year period.

According to the original plan announced for the structure, the location will be about three miles downstream from the center of Ogdensburg. The structure will cross the river from the westerly side of Chimney Point and follow a rocky shoal to the main navigation channel which coincides with the location of the channel planned for ultimate development. The main cantilever will be 840 ft. long, providing an 800-ft. clear channel width.

The river, at this location, is almost 7,000 ft. wide and the long approaches will come to grade at the shorelines. The Canadian terminus will be at the intersection of the Canadian River Highway with the Kings Highway to Ottawa, an important junction point in the arterial highway system of the province.

### Commission history

The St. Lawrence Bridge Commission was appointed by Governor Roosevelt in 1930. Following engineering studies by the firm of Modjeski, Masters & Chase, three bridges were recommended, one in the Thousand Islands section, near Alexandria Bay; another at the International Rapids section near Massena or Cornwall, and a third about midway between the other two, linking Ogdensburg, N. Y., and Prescott, Ont. It was further proposed that the bridges be built as toll structures by a public body and the present authority is the result.

Several weeks ago the opening of a highway deck on the old railroad bridge at Cornwall marked the first of the three projects to be completed. The new Ogdensburg bridge will be under way shortly, and the Alexandria Bay project is still indefinite.

## New York's East River Bridges Inspected for Needed Repairs

A special survey of the four bridges over the East River in New York City is being made under the supervision of L. S. Moisseiff and Holton Robinson, who have been engaged for the work by Frederick J. H. Kracke, Commissioner of the Department of Plant and Structures. The survey is counted upon to produce information for a major program of reconditioning and repair. The bridges involved are the Queensboro cantilever at 57th St. and the Williamsburgh, Manhattan and Brooklyn suspension structures near the lower end of the island.

## Political Poll to Be Made of Missouri Highway Department

A political poll is to be made of the employees of the Missouri state highway department, including 3,000 regular and temporary workers, at the request of Governor Guy B. Park. The poll is to be a non-political appraisal, according to reports.

The object of the tabulation is to secure facts as to the political connections of those in the department, following complaint that the number of Republicans was out of proportion to the existing state political situation. Previously, the state highway commission has always refused to make this type of classification, although in 1925 such a tabulation was started, but proved of little significance since most of the employees listed themselves as "independent." The present poll, it is understood, eliminates this classification, and requires the designation "Democrat" or "Republican" to be used.

## Gasoline Line Brings Water To Towns in Drought Area

Through a new and as yet unused gasoline pipe line the Great Lakes Pipe Line Company, of Kansas City, Mo., is pumping from 0.5 to 0.75 m.g.d. of water from Kansas City, Kan., to drought-stricken communities as far distant as Des Moines, Iowa. No charge is being made for the water by the eight oil companies that own the pipe line. The water is purchased by the oil company through its regular meter in the Fairfax Industrial District in Kansas City, Kan., and is supplied by the city filter plant at Quindaro. Gasoline pumps are being used for pumping the water. Storage tanks of 30,000 bbl. capacity at Ridgway and Osborne, Mo., are kept filled and water is supplied Plattsburg, Mo., and Osceola, Ia. Plans are also being made to furnish Cameron, Mo.

## Missouri to Force Collection of Sales Tax on City Water Revenues

The attorney-general of Missouri has been authorized by the state auditor to file suit immediately against Kansas City to collect $4,934 covering the state sales tax and penalties on the revenues of the municipally owned waterworks plant. The city has refused to pay the sales tax on these revenues. A similar suit, according to reports, will be filed against the St. Louis water department as soon as the state collectors compile figures on the revenues.

The Kansas City and St. Louis suits will involve a legal test of the question as to whether municipally-owned utility plants are to be subject to the state sales tax of one-half of 1 per cent on all retail sales, utility services and certain other miscellaneous services. Many of the municipally-owned plants in the state have been paying the tax since it went into effect last January, but the two large water departments and several others have refused to pay, claiming exemption.

According to estimates the suit against the St. Louis department will claim a tax, with penalties, of $9,000 to $10,000.

# Intercepting Sewers and Treatment Plants Recommended for Pittsburgh District

IMMEDIATE construction of a system of intercepting sewers to serve the "triangle" section of Pittsburgh has been recommended to the mayor and city council of that city by the department of public works. The further recommendation is made that a sewage treatment plant to provide sedimentation and sludge disposal be constructed on the north side of the Ohio River just below the Point.

The report states that there is immediate necessity to remedy sanitary conditions along the shores of the Allegheny, Monongahela and Ohio rivers, particularly in the vicinity of the various sewer outlets, some 200. Sewage discharge into the shallow water along the shores results in offensive conditions. There is also a marked tendency along some of the river shores for sewage to pool and to follow the shoreline. Conditions existing at present are unusually bad because of the low water stage.

The first district recommended for attention is the one extending along the south shore of the Allegheny river from about 14th St. to the Point, and along the north shore of the Monongahela river from the Try St. sewer outlet to the Point. Next in point of necessity is the north shore of the Allegheny river, from the vicinity of Herrs Island to the Manchester bridge.

The project recommended includes intercepting sewers to receive the dry-weather flow from the various existing combined sewer outlets and to carry it to the new treatment plant. This plant would be of the settling-tank type with provision for digestion and dehydration of the sludge. A pumping station would be built at or near the Point and the sewage carried across the river by pipe lines.

The report strongly urges the construction of the interceptors before the river-front improvements planned by the Allegheny County authorities are built.

A system so constructed could later be extended up and down the north shore of the Ohio and Allegheny rivers to serve that territory for a considerable distance.

The project recommended is part of a general plan now contemplated by the department of public works. Complete plans will require about twelve installations, consisting of small sewage treatment plants at or near the outlets of the main trunk sewers, to which points the sewage flow from the adjoining outlets will be concentrated. The report concludes that because of the general conditions of river flow in the Pittsburgh area, sedimentation will provide an adequate degree of treatment for the sewage.

The technical report on the Pittsburgh sewage treatment problem was presented to Leslie M. Johnston, director of the department of public works, by Charles M. Reppert, chief engineer of the department. On the basis of this report Mr. Johnston made the recommendation for interceptor and plant construction in a supplemental report to the Mayor.

## Power Commission Decision Settles Two Important Issues

Fixing 6 per cent as the standard rate of interest during the construction period and limiting the time in which a part of the initial investment in a power project can be carried in suspense were two important points decided by the Federal Power Commission in a recent decision in the case of the Portland General Electric Co., licensee, to determine the actual legitimate cost of construction of the original Oak Grove power project.

The project is located on the Clackamas River in Oregon and the decision fixed the "actual legitimate cost of construction" at $9,131,710. The commission reduced the claimed cost by $35,334 and disallowed $206,437 out of the $887,928 claimed for interest during construction, making the total reduction $241,772.

For a second unit of this power development, the claimed cost of $1,101,964 was reduced by $277,885, including $212,916 disallowed on the interest as computed by the licensee.

### Points settled

Two important issues were decided by the commission in this case. One disallowed the interest rate claimed by the licensee, and fixed 6 per cent as the fair rate of interest during construction. The commission also determined the period in which a part of the initial investment in a power project can be carried in suspense.

In opinion No. 12, drafted by Commissioner Claude L. Draper, the commission holds:

"That the theory that a proportion of the initial investment in a project should be carried in suspense after completion of the first unit until other project units are constructed, permitting interest to run on such 'unused capacity,' is not in conformity with the Federal Power Act and is unsound in principle."

## Additional Explanations Issued By Construction Code Authority

The Construction Code Authority has issued explanations 28 and 29 to its series of interpretations covering questions which have been raised.

In Explanation 28, the authority states that, while it is impracticable to set a minimum percentage of change in the estimated cost of a project justifying the inviting of new bids previous to the elapse of ninety days, it is the joint responsibility of the awarding authority and his Code Authority to determine whether there has been sufficient change made.

Explanation 29 states that the code does not alter the existing legal right of a subcontracor to withdraw his bid, but that he may not modify his bid after the time set for its receipt by the general contractor. The question had been raised as to whether a special, or sub-contractor, having made an error in his price as given in his bid to the general contractor, and filed with the bid depository, has the right to withdraw his bid, or if he may be permitted to revise his bid to correct this error prior to the time when the general contractors' bids are to be received by the awarding authority.

# Loan Loss Insurance Taken by 2,300 Banks in Housing Campaign

*Washington Correspondence*

OF THE 18,000 lending institutions estimated by the Federal Housing Administration as eligible to make loans for house repairs, about 2,300 had accepted, on Aug. 20, the insurance contract protecting them against 100 per cent of all losses provided the total of all such losses does not exceed 20 per cent of the total loans. This insurance is figured in the total amount of loans made during the entire time the insurance contract with FHA is in effect, not on the face amount of notes outstanding at any particular time. Notes paid off or matured are not deducted, in event of default on others, in determining the amount of the reserve. The insurance is said to be tantamount to a complete guarantee, as the highest known loss ratio on similar types of receivables has not exceeded 3 per cent.

Banks which professed themselves as "not interested" in making loans at "5 per cent" are lining up rapidly. FHA contends that the discount of $5 per $100 on a 1-year note payable in equal monthly installments and representing a cost to the borrower of 9.72 per cent is enough to cover handling costs and produce an attractive net return. To popular protests against the high interest rate, FHA replies frankly that any type of installment credit necessarily costs more than a straight commercial loan because of the extra expenses involved. The charge also makes allowance for the fact that the borrower is not required to maintain a deposit account. The property modernization credit is, however, by far the lowest in cost ever offered to borrowers for such purposes.

### Organization progressing

FHA still is struggling valiantly to make up for time consumed in organization. The regulations now in the hands of regional, state and district directors, financial institutions and civic and commercial organizations throughout the country have been supplemented by a manual detailing the plan for organizing community campaigns. This contains the best of the ideas used by cities which have conducted such campaigns in the past, together with added features made possible by the National Housing Act.

With the cooperation of the American Bankers Association, a banker has been named in each state to establish cooperation between financial institutions and community organizations where this is necessary to mobilize credit.

Although the prospect regarding building wage rates is for an increase rather than a reduction, according to President Green, of the A. F. of L., he has requested all trades to cooperate with the building trades in the job canvass and has pointed out to them that "not the least important source of work is in our own habitations."

In the meantime, families that are planning to build new homes must wait, if they wish to get the benefit of the provisions of the Housing Act for reorganization of home mortgage financing. There has been no official indication to date that this feature of the administration's program will get under way much before Spring.

## Court Orders New Trial in Engineer's Libel Case in Tulsa

On July 10 the supreme court of Oklahoma rendered an opinion in a nine-year-old $250,000 libel suit of W. R. Holway against the *Tulsa Daily World* in which it reversed the decision of a lower court and ordered a new trial. The case (*ENR*, p. 708, Apr. 20, 1926) grew out of statements published in the *Tulsa Daily World* to the effect that the Spavinaw project which Mr. Holway built, had failed to furnish water to Tulsa, that Mr. Holway was incompetent, that he was connected in some dishonorable way with real estate transactions, that he collected fees in excess of those due him, and that there was a reckless expenditure of money. The opinion is printed in the *Oklahoma Appellate Court Reporter* for July 13.

## Break in Large Water Main Causes Damage in New York

A break in a 48-in. water main in the heavily populated central district of the borough of Brooklyn, New York City, occurred in the early morning of August 20. The bursting of the main destroyed a large area of street paving and flooded many cellars, causing considerable property damage. The main, a cast-iron line laid in 1868, carried water from the Ridgewood reservoir. It was the principal lead to the intermediate service. The break occurred some time before 4:40 a.m., at which time it was reported to the water department. By bringing into service a parallel main on an adjoining street, water department forces had normal pressures restored shortly after 8:30 a.m. The failure involved one full length of pipe and an adjoining blowoff.

## East St. Louis to Purchase Private Water Company

The city council of East St. Louis has voted to purchase the East St. Louis and Interurban Water Co. under the terms of a franchise granted 20 years ago when the city retained the right to purchase the water system under an option effective every ten years, provided a year's notice of intention to purchase was given.

On June 10, 1933, the city served notice of its intention to take over the privately owned plant and property which serves East St. Louis and several surrounding communities, and on the last night before the option expired, the council decided to exercise its right. Appraisals will be made by the city, the water company and a neutral agency, and after a valuation is determined, the city proposes to issue bonds to purchase the system.

Following its action deciding on purchase, the council appointed the engineering firm of Consoer, Townsend, Older & Quinlan, Chicago, as appraisers for the city, and asked the company to appoint its appraiser.

The city council has the power to issue bonds without a vote of the people because the taxpayers would be under no obligations as the issue would be repaid by revenues from the water system. The present value of the water company property, according to the Illinois Commerce Commission, is $13,000,000.

# *Washington Notes*

By Paul Wooton
*Washington Correspondent*

The Federal Power Commission is to undertake the determination of actual expenditures of applicants for rights on the Tennessee River and on the Santee and Cooper Rivers. The Tennessee Valley Authority and the Public Service Authority of South Carolina have agreed to reimburse the applicants for out-of-pocket expenditures other than the promotional expenses involved.

While President Roosevelt indicated, prior to his departure for Hawaii, that the electric light and power code was not satisfactory to him in certain particulars, the code was not returned to the NRA. Secretary Perkins, according to reports, investigated the labor provisions of the code during the President's absence. It is fully expected at the NRA headquarters, however, that objections can be ironed out and approval ultimately secured.

### New power commissioner

Clyde L. Seavey arrived in Washington Aug. 14 and has entered upon his duties as a member of the Federal Power Commission. Mr. Seavey was formerly a member of the California Railroad Commission, of which he was president for six years. He served with the Commission for five years in other capacities, was formerly chairman of the California Tax Commission, city manager of Sacramento, was connected for many years with the tax department of the City of Pasadena and was a member of the State Civil Service Commission.

### Construction trends lower

The construction industry is again diagnosing its ills. Malcolm Pirnie heads a committee, revived by the Construction League, to consider the industry's problems.

"It seems inevitable," according to the League's official bulletin this week, "that, barring hoped-for stimulation from the activities of FHA, construction will reach a crisis this winter. And it is generally admitted that, while FHA has great potentialities, it cannot be a panacea from the very fact that the scope of its activities does not extend to even a major part of the normal field of the industry. The various indices of construction activity continue to graph a downward trend despite the activities of the governmental agencies designed to stimulate the industry. Construction contracts and materials figures, particularly with regard to the all-important private market, show slump trends, and observers of the industry predict that the total volume of work this year will hardly exceed last year's $3,100 millions."

### Reclamation plans

The importance of water storage and irrigation development is looming large in the administration's policy, as outlined by President Roosevelt in his cross-country trip. This is expected to include an economic study of the drought region in order to relate future power and irrigation developments to the best ultimate use of the available water supply.

Many of the existing projects have resulted from pressure brought by states and localities, individually, without reference to any comprehensive development program. Such individualistic promotions have resulted in a controversial muddle regarding water rights which may lead to legislation by Congress next winter defining the respective rights of the state and federal governments. For example streams such as the North Platte flow across state lines and every year there is a shortage which results in constant controversy between Wyoming and Nebraska irrigators.

## Change to Sea Lock at Bonneville Recommended in Report

Provision for a ship lock through the Bonneville Dam on the Columbia River near Portland, Ore., instead of a barge lock as originally designed and now under construction, is recommended in a recent report by Col. T. M. Robbins, Division Engineer, U. S. Army. The report shows a saving of $1,900,000 in the construction of a lock capable of carrying ocean going vessels if this lock is provided in the initial construction of the dam, as compared to its later construction, after the dam with barge lock is completed.

The barge lock was designed to be 360 ft. long, 76 ft. wide, with a low-water depth of 15 ft. over the sill. The sea lock recommended in its place would be 500 ft. by 76 ft. with a minimum depth of 27 ft. The maximum lift is 66 ft. Additional cost of this enlarged lock is estimated at $1,200,000.

The report indicates that if the barge lock is provided in the initial construction and the decision is made later to install locks for sea going vessels, the cost to convert the single-lift lock to a double-lift lock would be $3,100,000.

Further, the report points out that a sea lock at Bonneville for ocean going vessels, to be of use, would necessitate the construction of a ship channel in the river between Vancouver, Wash., and The Dalles, Ore., and that such channel improvement "does not appear to be justified at this time."

# *Personals*

WILLIAM FUDGE, for the last three years a superintendent in the organization of the Six Companies, Inc., on the Boulder Dam project, in charge of gravel pit operations, has moved to the Bonneville project in Portland, Ore., remaining with the same organization.

J. H. ALLDREDGE, for the past ten years chief transportation and rate expert for the Alabama Public Service Commission, has been appointed transportation economist for the TVA. His duties will include studies of freight rates and general transportation conditions in the Valley.

HUGH N. WOOD has been named engineer of the county which includes Louisville, Ky. The appointment marks a new policy which severed the two positions of county surveyor and county engineer. Mr. Wood is a graduate of the University of Kentucky, 1905, and had extensive railroad and construction experience before serving as location engineer for the state highway commission for the past four years.

BRENNEMAN & SWINFORD, a firm of architects and engineers, has been organized and is temporarily located at 3607 Chestnut St., Philadelphia, Pa. John S. Brenneman, a graduate of the school of architecture, University of Pennsylvania, has spent much of his life in Shanghai, China. Charles R. Swinford is an engineer who has done professional work in New York City, Chicago and Detroit. The organization expects to move to China within a few weeks to act as architects and engineers for development work in one of the provinces in southwestern China.

# *Obituary*

CALVERT C. MCCABE, president of the James F. McCabe Co., Baltimore, Md., railroad contractors, died on Aug. 16 at his home in Towson, near Baltimore.

DAVID FRANCIS EVANS, 73, founder of Evans Brothers Construction Co., Birmingham, Ala., died in that city on Aug. 6. Mr. Evans came to Birmingham from Wales in 1888, and organized the construction firm with his brother. He was active in the business at the time of his death.

ELMER C. GOODWIN, examining engineer for the department of sanitation, New York City, died after a brief illness at the age of 46. He was a native of New York and graduated from Columbia University in 1910. He was a past president of the International Association of Public Works Officials.

CHARLES P. PERKINS, retired civil engineer, died in Rosemont, Pa., on Aug. 19 at the age of 89. He graduated from the University of Pennsylvania in 1863, and later attended the Rensselaer Polytechnic Institute. For the twenty years immediately preceding his retirement he was with the engineering department of the Pennsylvania Railroad.

ARTHUR W. RING, for many years superintendent of the contracting organization of L. D. Willcut & Sons Co., Boston, Mass., died in that city on Aug. 14 at the age of 56.

PAUL H. BRANGS, at one time active in engineering development in the Roseville section of Newark, N. J., died in Orange, N. J., Aug. 14, at the age of 76. His death was caused by injuries received when he was struck by a truck.

ROY ALLEN WHITE, resident engineer of the Los Angeles Flood Control District on the San Gabriel river outlet work, died at a Hollywood hospital Aug. 11 following an operation. Mr. White performed very strenuous work at the time of the flood near Los Angeles on Jan. 1, 1934, and retained the effects of the work he did at that time. He was a graduate of the University of Iowa in 1908, and spent several years in the Bureau of Public Works, Manila, P. I. He was in military service during the Boxer Rebellion in China and then spent three years in construction work in that country. From 1920 to 1930 he was engaged in construction work as a contractor on many Western projects.

PHILIP K. SCHUYLER, president Federal Bridge Co. and secretary American Toll Bridge Association, died at Walter Reed Hospital, Washington, D. C., on May 29, 1934. Mr. Schuyler graduated from the University of Wisconsin in 1921. He was assistant bridge engineer for the North Carolina state highway commission from 1922 to 1925, and later took a position as associate professor of highway engineering at the University of North Carolina. Since 1926 he had held positions as bridge engineer for the Mexican department of high-

ways, as engineer for the bureau of public roads, and as associate professor of highway engineering at George Washington University. During recent years Mr. Schuyler was actively interested in the building and operation of toll bridges and was the sponsor of the American Toll Bridge Association.

JOHN FRANCIS SULLIVAN, former planning commissioner of New York, died in a hospital in Haverhill, Mass., on Aug. 14, at the age of 55. Major Sullivan, who was the first to hold the New York City planning office, was appointed by Mayor Walker at the time of its organization. Prior to his death he had been supervising relief projects in Massachusetts for several months. He graduated from Clemson College in 1900 and served for some time in the Navy. During the war Major Sullivan was connected with the construction of the munition plant at Nitro, W. Va., and he was also on the engineering staff for the Muscle Shoals development. Following the war he was in private consulting practice in New York until 1924, when he entered the city service, acting as special adviser to Mayor Walker prior to serving as general adviser to the Board of Estimate on city planning, zoning and engineering work. In 1930 he was appointed to the position of city planning commissioner.

HENRY R. BUCK, prominent consulting engineer in Connecticut, died at his home in Hartford on Aug. 11 at the age of 58. He graduated from Yale University in 1896 and until 1905 held various positions in the city engineer's department of Hartford. Since 1905 he was in private practice under the firm name of Ford, Buck and Sheldon, and more recently as Henry Robinson Buck, Inc., specializing in factory design and sanitary engineering. He served as director of the Am. Soc. C. E. from 1931-1933.

SVEN SVENNINGSON, chief engineer of the Shawinigan Water and Power Company, of Montreal, Canada, and of its subsidiary Shawinigan Engineering and Power Engineering Companies, and one of the leading hydro-electric engineers in Canada, died very suddenly on August 10th while on vacation at Bailey's Island, Maine, at the age of 51. Born in Oslo, Norway, he graduated from the Polytechnic Institute of Christiania and was engaged in engineering in Norway until 1909, when he came to this country. From 1909 to 1912 he served with various engineering companies associated with water-power work, moving to Canada in 1913 as assistant engineer with the Cedar Rapids Manufacturing and Power Company, Montreal, now associated with the Shawinigan companies. He remained with this organization after 1915 and served as chief engineer of the Shawinigan companies for the last fifteen years.

# CONSTRUCTION STATISTICS OF THE WEEK

ENGINEERING awards for the week at $18,271,000 are about one per cent below last week, about 13 per cent below the previous four weeks average and 23 per cent higher than the average week in August, 1933. Both private awards, at $3,382,000, and federal awards, at $5,719,000, are higher, but state and municipal are down to $9,170,000.

This loss is largely in highway awards, which are down to $2,548,000, the lowest week this year. Waterworks and sewers are also lower this week as are commercial buildings. Bridge awards are heavier, up to $2,400,000, industrial buildings are up to $1,500,000, public buildings to $2,600,000 and earthwork, irrigation and drainage at $5,800,000, are 129 per cent over last week.

Large awards for the week include the cables and suspenders for the Tri-borough bridge, New York City, $793,000, the Bath Street Viaduct, Baltimore, $894,000, and grade crossing elimination contract by the New York Central R. R., Hoboken and Weehawken, N. J., $480,000. The Minneapolis-St. Paul Sanitary District let contract 104 for tunnels, $456,000; Platte Valley Public Power and Irrigation District awarded earth dam and dikes for Sutherland Reservoir, Nebraska, $712,000; U. S. Engineers awarded dikes and revetments on Missouri River, $1,855,000 and $1,659,000, and the Bureau of Reclamation awarded a $775,000 contract on the All-American Canal.

State and municipal bond sales at $2,789,000 are 170 per cent higher than last week, and federal PWA allotments for non-federal work aggregate $24,053,000.

## CONTRACTS

(Thousands of Dollars)

| | Weekly Average Week Aug. 1933 | Prev. 4 Weeks | Aug. 23 1934 |
|---|---|---|---|
| Federal Government | $600 | $3,499 | $5,719 |
| State and municipal | 7,300 | 14,810 | 9,170 |
| Total public | $7,900 | $18,309 | $14,889 |
| Total private | 6,913 | 2,604 | 3,382 |
| Week's total | $14,813 | $20,913 | $18,271 |
| Cumulative to date: | | | |
| 1933 | $551,221 | 1934 | $821,418 |

## NEW PRODUCTIVE CAPITAL

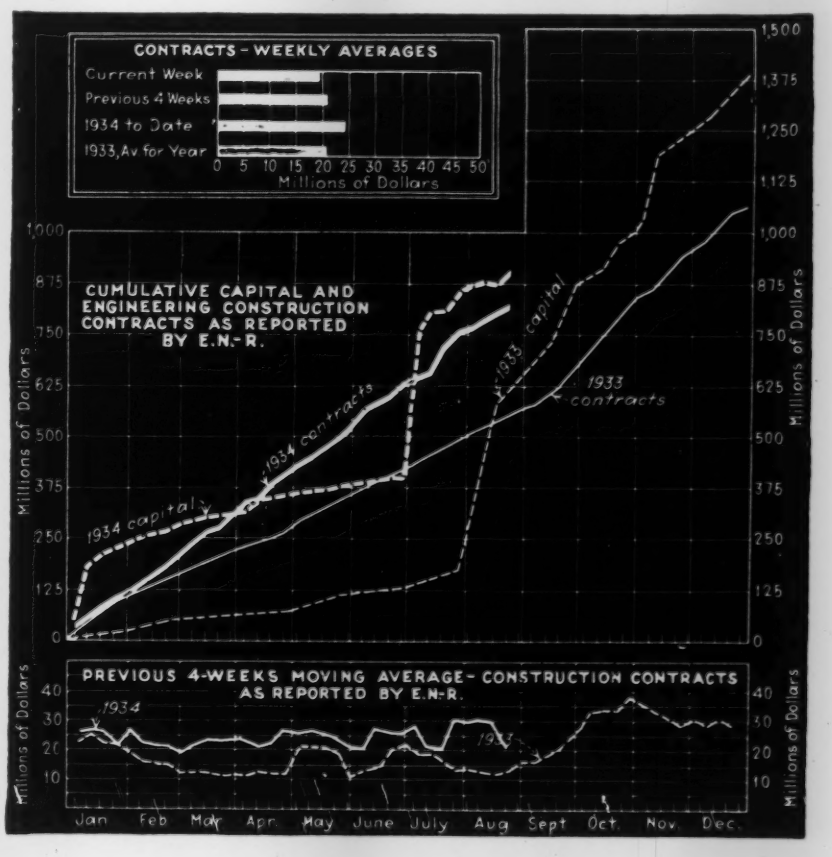
(Thousands of Dollars)

| 1934 | Week Aug. 23 | Cumulative |
|---|---|---|
| State and municipal | $2,789 | $224,748 |
| PWA allotments, S&M | 24,053 | 596,433 |
| RFC loans, S&M | ..... | 9,463 |
| Corporate issues | 1,000 | 18,063 |
| PWA allotments, private | ..... | 54,272 |
| Total, Non Federal | $27,842 | $902,979 |
| PWA allotments Federal Constr. | 515 | 180,957 |
| Total new capital | $28,357 | $1,083,936 |
| Cumulative to date: | | |
| 1933 | $626,235 | 1934 $902,979 |

NOTE: These figures include private bonds, and stocks sold for productive purposes; state and municipal bonds for construction; PWA loans and grants to states and municipalities, including the special highway funds; PWA private loans, and allotments for Federal construction.

## INDEX NUMBER

| E.N.-R.- Cost | 1913 = 100 | 1926 = 100 | E.N.-R.- Volume | 1913 = 100 | 1926 = 100 |
|---|---|---|---|---|---|
| **Aug., 1934** | **198.40** | **95.37** | **July, 1934** | **128** | **56** |
| July, 1934 | 199.65 | 95.97 | June, 1934 | 119 | 50 |
| Aug., 1933 | 167.00 | 80.27 | July, 1933 | 65 | 28.5 |
| 1933 (Av.) | 170.18 | 81.80 | 1933 (Av.) | 102 | 45 |
| 1932 (Av.) | 156.97 | 75.45 | 1932 (Av.) | 127 | 56 |
| 1931 (Av.) | 181.35 | 87.17 | 1931 (Av.) | 220 | 96.5 |



# Construction Equipment and Materials

## Vibrating Screed Board For Concrete Paving

A vibrating screed board for concrete highway pavement has been announced by Munsell Concrete Vibrators, Jersey City, N. J. The vibrating screed board is suspended in a frame or carriage and is free to move vertically. It rests directly on the concrete, free from the forms.

**Munsell vibrating screed board**

The screed board is of the pan type, 12 in. wide with curved edges front and rear. The motion of the vibrator moves the frame at the rate of 7 to 10 ft. per minute.

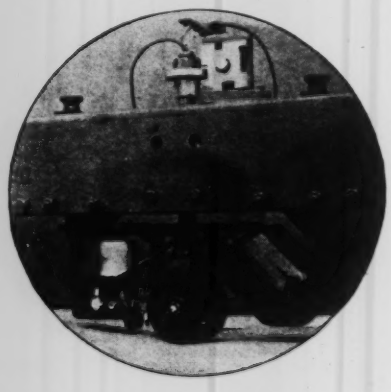
## Road Surface Tester Marks Defective Spots

A road surface tester which squirts a stream of marking fluid on high or low spots has been introduced by the H. & H. Manufacturing Co., Elyria, Ohio.

The tester consists of a framework on wheels on which is mounted a free-moving roller with an extension arm, constructed so that the roller with its extension arm can follow the profile of the road independently of the truck-wheels. The upper part of the extension arm is arranged to establish an electrical contact if the roller moves in either direction beyond permissible limits. Whenever this contact is made, a solenoid-operated valve, mounted on the frame, is energized and causes the marking fluid to be discharged on the defective spot.

The contact established by the extension arm also lights an indicating lamp on the upper part of the road tester so that the crew foreman may make a preliminary inspection of the defective spots as the tester moves over each section of the road. The lamp and the solenoid valve are operated from a 6-volt battery on the tractor which pulls the tester.

**Movement of roller beyond limit of tolerance energizes solenoid and operates valve controlling flow of marking fluid**



## New Equipment in Brief

*Cutting Blowpipe.* The Linde Air Products Co., New York, N. Y., has announced a new oxy-acetylene cutting blowpipe, known as Oxweld Type C-24. The maker states that it has been designed essentially to serve as a general-duty cutting blowpipe, but is capable of doing heavier work if necessary. It is featured by a new design of cutting oxygen valve.

*Air-Cooled Engine.* The Wisconsin Motor Corp., Milwaukee, Wis., has brought out a heavy-duty 4-cylinder air-cooled engine of 6 to 16 hp. capacity. This engine is called model "AC4" and has a 2⅝-in. bore and 3¼-in. stroke. The engine develops 10 hp. at 1350 r.p.m. and 16 hp. at 2600 r.p.m. It is featured by light weight, weighing only 215 lb. with accessories. Complete unit with house, gas tank, etc., weighs 265 lb.

*Motor Trucks.* The addition of seven new models to the Marmon-Herrington line of all-wheel drive trucks has been announced. Two of the new models are gasoline-powered vehicles and five are equipped with diesel engines. The new gasoline models include a four-wheel drive unit of 20 tons capacity and a six-wheel drive unit of 35 tons. The diesel models include three four-wheel drive vehicles, having a capacity of 5, 6 and 20 tons respectively and two six-wheel drive models, capacities 10 and 35 tons respectively.

*Anchor Bolt.* For tying new concrete to old the American Expansion Bolt Company, Chicago, has developed an expansion hook bolt. It finds a use in repair of concrete slabs cut for various reasons, for tying new slabs to old in road widening, for tying curbs to gutters, for widening piers and abutments, for tying approaches to bridges or any new to old concrete surface. The expansion device consists of a bolt with an upset end, a lead alloy sleeve and a hard metal cone against which a fluted expander can be driven to swell the lead sleeve to fit the drilled hole.

*Pavement Core Drills.* A core drill for mudjack work has been developed by the Sullivan Machinery Co., Chicago, Ill. The drill consists of a rotary mechanism arranged with a ratchet feed to force the core barrel into the rock or concrete. The rotary mechanism is driven by a gasoline engine. All the mechanism is mounted on a four-wheel hard-rubber-tired truck and is self-propelled by chain drive from the gasoline engine. The manufacturer states that in tests thus far run, it has been found that the average length of time required to drill through 9 in. of pavement is about 5½ minutes.

## New Publications

THE LONGYEAR PROSPECTOR. Bulletin No. 37. 8½x11. 8 pages. E. J. Longyear Co., Minneapolis, Minn.

SEAMLESS STEEL FITTINGS FOR WELDING. 8½x11. 64 pages. Taylor Forge & Pipe Works, Chicago, Ill.

PENN-MOTOR PUMPER UNIT. 8½x11. 12 pages. Pennsylvania Pump & Compressor Co., Easton, Pa.

CONTEMPORARY SPANDREL DESIGN. 8½x11. 24 pages. Aluminum Co. of America, Pittsburgh, Pa.

BUCYRUS ERIE 10B. 8½x11. 24 pages. Bucyrus Erie Co., South Milwaukee, Wis. A ⅜-cu.yd. shovel.

WESTERN PRIMARY BREAKER No. 183. Bulletin 34-B. 8½x11. 4 pages. Austin Western Road Machinery Co., Chicago, Ill.

AUSTIN DUAL AND SINGLE DRIVE MOTOR GRADERS. Bulletin 1332. 8½x11. 24 pages. Austin Western Road Machinery Co., Chicago, Ill.

ELECTRIC POWERED HYDRAULIC DREDGE. Bulletin No. P7. 8½x11. 8 pages. American Manganese Steel Co., Chicago Heights, Ill.

LITTLEFORD HIGHWAY EQUIPMENT. Bulletin J-1. 8½x11. 12 pages. Littleford Bros., Cincinnati, Ohio.

BELT CONVEYOR IDLERS. Bulletin No. 52. 8½x11. 12 pages. The C. O. Bartlett & Snow Co., Cleveland, Ohio.

## Business Notes

THE MASTER BUILDERS CO., Cleveland, Ohio, announces that A. H. Meyer has been appointed advertising manager.

MACWHYTE CO., Kenosha, Wis., announces that the new address of the company's Pittsburgh office and warehouse is 704 Second Ave.

MISSOURI PORTLAND CEMENT CO., St. Louis, Mo., announces that M. Moss Alexander has been made president, filling the vacancy caused by the death of Harry L. Block.

THE CHAIN BELT CO., Milwaukee, Wis., has recently completed the transfer to Milwaukee of all the manufacturing operations of its wholly owned subsidiary, the Stearns Conveyor Co., of Cleveland, Ohio.

LUKENS STEEL CO., Coatesville, Pa., announces that Everett Chapman has been elected vice-president. Since 1930 Mr. Chapman has been director of engineering and research.

REVERE COPPER & BRASS, INC., New York, N. Y., announces that A. J. Howell has been appointed manager of the Pacific Coast district, and will make his office in the Bass Building, San Francisco.

WESTERN WHEELED SCRAPER CO., of Aurora, Ill., and AUSTIN MFG. CO., of Chicago and Harvey, Ill., have consolidated and will operate under the name of WESTERN-AUSTIN MANUFACTURING CO. The general office of the consolidated corporation will be at Aurora. The Austin-Western Road Machinery Co. will continue to handle the sales of the Manufacturing Co.

THE ADNUN ENGINEERING & MANUFACTURING CO., of Nunda, N. Y., announces that Dave Kennedy has been appointed Midwest sales manager.

REVERE COPPER & BRASS, INC., will sell and distribute Streamline soldered fittings as manufactured by the Streamline Pipe & Fittings Co., Port Huron, Mich., a division of the Mueller Brass Co.

HARNISCHFEGER CORP., Milwaukee, Wis., announces that Charles B. Foster has been appointed sales manager.

INGERSOLL-RAND CO., Phillipsburg, N. J., announces that Batt L. Spain, formerly manager of turbo-blower sales for the General Electric Co., has been made manager of the turbo-blower department.

KENTUCKY ROCK ASPHALT CO., Louisville, Ky., announces that Dan D. Thomson has been elected president to succeed W. H. Tarvin.

INGERSOLL-RAND CO., Phillipsburg, N. J., announces that it has acquired the General Electric Company's turbo-blower business and the exclusive rights to the General Electric patents in that field.

JOSEPH T. RYERSON & SON, Chicago, Ill., announces that Harvey Dieterich has been made assistant vice-president in charge of the operations of the structural and special order department. Ainslie Y. Sawyer has been appointed assistant general manager of sales.

THE DORR CO., INC., New York, N. Y., and OLIVER UNITED FILTERS, INC., San Francisco, Calif., announce that it has been agreed to dissolve the DORR-OLIVER CORPORATION and that the two companies will hereafter operate independently of each other.

# CONSTRUCTION REPORTS

## WATERWORKS

### PROPOSED WORK

**Calif., Eureka**—Election Aug. 31, to vote $959,000 bonds to secure loan and grant of P.W.A. to finance construction of new water system, incl. dam on Mad River, tunnel, reservoir and pipe line. P.W.A. has granted $318,000 towards project. C. C. Kennedy, Call Bldg., San Francisco, engr. Noted Aug. 10.

**Calif., Los Angeles**—Dpt. Water & Power, 207 South Bway., plans distribution mains $30,000; major trunk lines $30,000; automotive equipment $9,800; service installations and replacements $30,000; and miscellaneous $17,162.

**Calif., Truckee**—Truckee Public Utility Dist. plans to purchase and improve privately owned water system. $45,000.

**Ill., Altamont**—City soon takes bids waterworks and distribution system, incl. wells, pumps, motors, tank on tower, distribution mains, fire hydrants, valves, etc. $41,000. W. A. Fuller Co., 2916 Shenandoah Ave., St. Louis, Mo., engrs. Noted May 17.

**Ill., Chicago**—City preliminary plans completed constructing water filtration plant and breakwater on lake front, Chicago, 67th to 79th Sts. $22,000,000. P.W.A. project. O. B. Carlish, 402 City Hall, engr.

**Ia., Fort Dodge**—City indefinitely postponed taking bids improving waterworks and distribution system. $74,000 allotted by P.W.A. J. W. Pray, Fort Dodge, supt. waterworks. Noted Aug. 2.

**Kan., Chanute**—City defeated $35,000 bonds for water softening plant, auxiliary piping and appurtenances. R. B. Reeves, Chanute, engr. Noted July 12.

**Kan., Medicine Lodge**—City plans water supply system. $35,000. E. T. Archer & Co., 609 New England Bldg., Kansas City, Mo., engrs. Noted Jan. 18.

**Mich., Detroit**—Dpt. Water Supply, G. H. Fenkell, genl. mgr., 735 Randolph St., making plans rebuilding 12 in. pipe line for water main (submerged) in trench across bottom of river, trench about 7½ ft. deep, from Water Works Park to Bell Isle, $15,000.

**Minn., Blue Earth**—City plans new well or extend watermains to fair grounds. $2,500. W. Enger, city clk.

**Minn., New Ulm**—City plans purchasing pump to raise water in well now under construction to reservoir. C. W. Frank, city engr. Noted July 26.

**Mo., Doniphan** — City, declined to accept $18,000 P.W.A. grant and loan for waterworks improvements, because it had not been able to get favorable action in Washington on application for P.W.A. grant of $24,000 and $64,000 loan for municipal light and power plant. W. A. Fuller, 2916 Shenandoah Ave., St. Louis, engrs. Noted Apr. 26.

**Mo., St. Charles**—City election Sept. 8, $65,000 for water filtration plant, filter equipment, and waterworks improvements. P.W.A. allotted $65,000 grant. Noted July 19.

**Mo., Salem**—City indefinitely postponed improvements to waterworks and light plant. P.W.A. application for grant and loan held up in Washington. W. A. Fuller Co., 2916 Shenandoah Ave., St. Louis, engrs. Noted Nov. 16.

**Mont., Billings** — City plans water supply system. Black & Veatch, 700 Mutual Bldg., Kansas City, Mo., engrs.

**N. M., Hatch**—City plans waterworks improvements. $28,000. P.W.A. loan granted. H. O. Garst, Las Cruces, engr. Noted May 11.

**N. Y., Bethany**—Bd. Supervs. Genesee Co., Batavia, plans 100,000 gal. reservoir, and improving water supply at county home. $15,000.

**N. Y., Buchanan**—Municipality plans waterworks system. $103,000. P.W.A. funds allotted. Hudson Valley Eng. Co., 906 South St., Peekskill, engrs.

**N. Y., Delmar**—Bethlehem Water Dist. which includes Delmar, Elsmere, Slingerlands in Albany Co. voted to construct 12 m.g. storage reservoir, new pipe line from reservoir to the villages and water softening plant. $95,000. W. D. Jordan, Delmar, engr. P.W.A. project. Noted Aug. 16, under "Bethlehem."

**N. Y., East Bloomfield**—Voted $36,920, installing water supply system in village. Noted Nov. 16.

**N. Y., Hamburg**—Municipality plans waterworks system. $50,000. P.W.A. funds allotted. C. P. Nicholson, Pierce Ave., engr. Noted Apr. 12.

**N. Y., Olean**—Municipality plans waterworks system. $109,000. P.W.A. funds allotted. G. Miles, Olean, engr. Noted July 5.

**N. Y., Phelps**—Village Trustees plans new reservoir for waterworks. Election Aug. 31, $21,000 bonds for same.

**N. Y., Ransomville**—City plans water supply system. $51,000. P.W.A. funds allotted. Fretts, Tallamy & Senior, 5488 Main St., Williamsville, engrs. Noted Apr. 19.

**N. Y., Yonkers**—City, City Hall, plans rehabilitating low service pumping station. $74,000. P.W.A. allotment. C. J. Sheridan, city engr.

**O., Elyria**—City plans feeder water mains from pumping plant at Lorain to Elyria, $408,000. P.W.A. funds granted. J. Powell, city engr.

**Okla., Comanche**—City, preliminary plans additional deep well, motor, triplex pump and piping for water supply. $5,000. Private plans.

**Okla., Gould**—City preliminary plans deep well, triplex pump, motor and piping for additional water supply. $6,000.

**Okla., Miami**—City, preliminary plans earthen dam, spillway, water storage reservoir. $20,000. Private plans.

**R. I., Exeter**—State, F. J. Farnell, chn. P. Welfare Comn., State House, Providence, bids in September, 100,000 gal. steel water tank at State Institution, $28,637. P.W.A. project. Allen & Reed, Inc., 178 Dorrance St., Providence, engrs. Noted Jan. 11.

**Tex., Beeville**—New Braunfels & Gulf Water Supply Co., plans spring water line from New Braunfels to Corpus Christi, 186 airline mi. to supply Corpus Christi and towns en-route. $2,000,000. P.W.A. project.

**Tex., Dallas**—City Council has notified P.W.A. officials in Washington that the city cannot accept an $840,000 loan and grant for waterworks improvements due to the fact that they cannot pledge water revenues to retire the loan. Noted July 26.

**Utah, Spanish Forks**—City voted $88,000 bonds for waterworks improvements. Caldwell & Richards, Templeton Bldg., Salt Lake City, engrs. Noted July 19.

**Ont., London**—Public Utilities Com., E. V. Buchanan, genl. mgr., making plans 5 m.g. reservoir. $135,000.

### BIDS ASKED

**Ill., Ramsey**—Aug. 31, by Bd. Village Trustees, A. M. Fromn, pres., pumps, pump house, watertower, distribution system. $34,000. W. A. Fuller Co., 2916 Shenandoah Ave., St. Louis, Mo., engrs. Noted July 12.

**Mass., Sterling**—Aug. 28, by Town, A. Anderson, chn. Water Comn., Town Hall, constructing 15 driven wells, installing suction and discharge piping for capacity tests, installing permanent suction piping, P.W.A. Project Docket 4892. Est. about $50,000. Fay, Spofford & Thorndike, 44 School St., Boston, engrs. Noted Aug. 2.

**Mich., East Lansing**—Aug. 27, by H. W. Lott, city clk., furnishing, installing equipment only for waterworks improvements, incl. water purification and iron removal plant, deep well with deep well turbine pump, electrically operated. Loan and grant of $50,000. Part of work is to be done by force account. F. W. Dodge, city engr.

**Mich., Grand Rapids**—Aug. 31, by G. C. Dillman, dir. P. Serv., waterworks improvements and extensions to incl. distribution header at pump plant, completion of head house at filtration plant and elevated 500,000 gal. steel storage tank, for city. $73,300. P.W.A. project. Noted Oct. 26.

**Minn., Green Isle**—Aug. 27, by Village, H. Groetsch, clk., 25,000 or 30,000 gal. steel tank on 80 ft. tower or 25,000 or 30,000 gal. wood tank on new or second hand tower. Former bids rejected. E. G. Briggs, 1520 Hythe St., St. Paul, engr. Noted Mar. 22.

**Mo., Poplar Bluff**—City takes bids about Sept. 1, new river intake for municipal water and power plant. $7,000. W. A. Fuller Co., 2916 Shenandoah Ave., St. Louis, engrs.

**Mont., Eureka**—Sept. 4, by City, E. Campbell, supt. Waterworks, constructing water system replacements, 18,300 lin.ft. 4- to 8-in. c.i. pipe, etc. $30,000. P.W.A. project. R. J. Hale, Missoula, engr. Noted Aug. 9.

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*Federal Government projects are classified under heading denoting type of work and designated by symbol of †*

◆

**N. J., Ramsey**—Aug. 28, by Boro Council, constructing division wall and lining for reservoir. J. A. Conklin, Ramsey, engr.

**N. Y., Farmingdale**—Aug. 28, by Dpt. Education, Education Bldg., Albany, water supply (pump house and pump foundation, deep well turbine) for New York School of Applied Agriculture. F. P. Graves, comr.

**N. Y., Washington Mills**—Sept. 5, by New Hartford Town Bd., J. F. Seaton, clk., Campus Hall, installing water supply system in Washington Mills Water District, incl. 2- to 10-in. c.i. pipe and connections. To exceed $15,000. W. T. Field Engineers, Inc., Watertown, engrs. Noted Dec. 28.

**N. Y., Farmingdale**—Aug. 28, by Commissioner Dpt. Education, Education Bldg., Albany, water supply (pump house and pump foundation, and deep well turbine) for New York State School of Applied Agriculture.

**N. Y., Forest Hills**—Sept. 26, by Superintendent P. Wks., c/o W. E. Haugaard, State Office Bldg., Albany, pumps and service connections, Forest Hills Pumping Station (Pump House 31), Grand Central Parkway and Union Turnpike, Queens Boro.

**N. Y., Mayville**—A. M. Burnett taking bids complete water well drilling equipment. $1,500 or more.

**O., Grafton**—Sept. 1, by Village Council, constructing waterworks system, wells, tank, pump and distribution system. $20,000. R. F. MacDowell, 341 Chester-Twelfth Bldg., Cleveland, engrs. Noted Apr. 19.

**Pa., Coraopolis**—Sept. 4, by W. E. Cain, secy., Boro Council, 2 m.g.p.d. water softening plant and appurtenances, incl. motor driven centrifugal pump, electric wiring, heating and plumbing. Edeburn Cooper & Co., Law & Finance Bldg., Pittsburgh, engrs.

**Pa., Reading**—Sept. 5, by City, City Hall, altering 18th Ward Standpipe 2 and constructing 18th Ward Standpipe 3, incl. 2 m.g. steel standpipe with concrete foundation, excavation, grading, accessories, 200,000 gal. steel standpipe, incl. placing steel dome roof on same. Cumru Twp., west of Morgantown Rd., Contr. 71. A. R. O'Reilly, ch. engr. Bureau Water.

**Pa., Pennburst**—Sept. 5, by J. L. Hanna, Dept. Property & Supplies, Harrisburg, constructing pump house, installing deep well pump, pneumatic water system and electrical installation, latter includes relocating existing 3 phase 4100 volt transmission system, and installation of additional equipment, concrete founds. To exceed $30,000.

**Okla., Nowata**—Sept. 10, by E. Choteau, city mgr., rebuilding present filter plant. $16,000. P.W.A. project. Bleack & Veatch, Mutual Bldg., Kansas City, Mo., engrs. Noted July 5.

**S. D., Frederick**—Aug. 28, by Town, O. Hukart, clk., 50,000 gal. steel tank on 100 ft. steel tower; furnishing, installing one hundred ten 5/8 in. cobl water meters. P.W.A. project. Dakota Eng. Co., Mitchell, engrs.

**Wis., Seymour**—Sept. 6, by B. F. Dean, city clk., constructing waterworks plant, incl. c.i. pipe and fittings, hydrants, valves, valve boxes, pump house and reservoir, elevated steel tank, deep well pump, pump and motor, electric automatic control panel and equipment for control of pumps, flow or turbine meter, corp stop, curb

†*Federal Government.*

***For official proposal advertising see Searchlight Section***

*Constr. News page 69*

Waterworks (Continued)

stops, stop boxes, copper pipe, lapping machine, and water meters. $110,000. A. E. McMahon Eng. Co., Menasha, engrs. P.W.A. project. Noted Sept. 7.

**CONTRACTS AWARDED**

**Calif., Beverly Hills**—City Council, furnishing 2 venturi tubes and recording water meters, to International Filter Co., 514 East 8th St., Los Angeles, $1,392. Bids July 31, awarded Aug. 14.

**Colo., Limon**—B. Lowther, consult. engr., 710 Colorado Bldg., Denver, furnishing, erecting complete with concrete founds., one 100,000 gal. elevated steel water tank for municipal waterworks, for City, to Chicago Bridge & Iron Wks., 37 West Van Buren St., Chicago, Ill., $92,034. Noted Aug. 2.

**Colo., Louisville**—City, constructing filtration plant and pipeline, to Stearns-Rogers Mfg. Co., 1720 California St., Denver, $30,000.

**Ia., Guthrie Center**—City, water treatment plant, 100,000 gal. tank on 60 ft. tower, 17,000 ft. 4- to 8-in. c.i. mains, fittings, 18 fire hydrants, to Pittsburgh-Des Moines Steel Co., 1015 Tuttle St., Des Moines, $50,000. **P.W.A.** Bids Aug. 7. Noted July 19.

**N. Y., Dansville**—City, constructing dam and reservoir, to Provo Bros., Inc., West Hiawatha St., Syracuse, Contractors awarded 150-200 tons steel piling, to Kalman Steel Co., Syracuse; steel, to Concrete Steel Co., Durston Bldg., Syracuse. Est. $65,000. **P.W.A.** Noted June 7.

**N. Y., Watervliet**—City, pumps, turbines for waterworks, to Turbine Equipment Co., 75 West St., New York, $10,690. **P.W.A.** Noted Apr. 5.

**N. C., Faison**—Town, complete water system, to Boyd & Goforth, Builders Bldg., Charlotte, $50,000. **P.W.A.** Bids Aug. 10. Noted Aug. 9.

**N. C., Lowell**—W. H. Holmes, mayor and Town Council, constructing 3 mi. 6- and 8-in. c.i. pipe, 1 mi. small water lines, elevated tank and appurtenances, to Smith-Pew Constr. Co., 435 Irwin St. N.E., Atlanta, Ga., $26,000. Est. $37,000. **P.W.A.** Noted June 7.

**N. C., Stanley** — Town, water and sewer system, to Boyd & Goforth, Builders Bldg., Charlotte, $99,804. Est. $100,000. **P.W.A.** Bids June 23. Noted July 19.

†**Oregon** — Bureau Reclamation, water and sewerage system at Bonneville Dam Project, to Parker Schram Co., Couch Bldg., Portland, $11,443.

**S. C., Jefferson**—Town, Town Hall, complete waterworks system, incl. materials, water tanks, hydrants, meters, pipe lines, etc., to Boyd & Goforth, Builders Bldg., Charlotte, N. C., $15,191. **P.W.A.** Bids June 21. Noted July 19.

**W. Va., New Cumberland**—City, reconstructing water system, incl. mains, new steel tank, to Gallagher & O'Hara, Youngstown, O., $57,430. **P.W.A.**

**Wis., Two Rivers** — City, filter equipment, piping and chlorinator for waterworks, to W. Elliott, Two Rivers, $31,666•••lift pumps and controls, to Allis Chalmers Mfg. Co., 1126 South 70th St., Milwaukee, $4,505•••elevated water tank, to Pittsburgh-Des Moines Steel Co., 31 South Dearborn St., Chicago, Ill., $27,500 •••watermains, valves, etc., to Bahr Constr. Co., Manitowoc, $11,032•••14 in. river crossing, to Greilling Bros., Green Bay, $7,900. Grand total $82,603. Bids June 7. Noted May 31.

## SEWERAGE AND WASTE DISPOSAL

**PROPOSED WORK**

**Calif., Carmel**—Bd. Trustees Carmel Sanitary Dist. have invited suggestions for methods of solving sewage disposal problems of district. They will consider written proposals in detail to be acceptable for submission to State Bd. of Sanitary Engineers, A. T. Shand, secy. Noted Mar. 29.

**Calif., Santa Ana**—Bd. Directors Orange Co. Farm Bureau, announced that S.E.R.A. has approved proposal to establish portable plant and experiment with same for one year for reclamation of sewage water at site of outfall sewer. This is to be used prior to proposed construction of permanent plant. $600,000-$800,000.

**Conn., West Hartford**—Town, F. Chamberlain, Town Hall, plans 4,000 ft. interceptor sewer line. $140,000.

**Ill., Carthage**—City election Sept. 19, $30,000, for sewage disposal plant. Noted Dec. 7.

**Mich., Detroit**—City and Wayne Co., application for appropriation of $23,000,000 to finance construction of a sewage disposal plant was rejected by P.W.A. office in Washington. Plan proposed sewage disposal plant on down-river site, with intercepting sewers and pumping stations to care for Detroit's sewage and that of other down-river municipalities, to clean up the river front and stop pollution of international water between Michigan and Canada. L. W. Lenhardt, comr. P. Wks. Noted July 20.

**Mich., Muskegon** — City selected Consoer, Townsend, Older & Quinlan, engrs., Engineering Bldg., Chicago, Ill., to prepare plans for sewage treatment plant, $35,000.

**Minn., Minneapolis**—City has been refused permission by P.W.A. to construct Sects. A and B of North Minneapolis Intereceptor Sewer in 2nd St., from Hennepin Ave. to 10th Ave. N., by day labor. Will readvertise. Noted July 26, under "Contracts Awarded."

**N. J., Hillside**—Union Co. Joint Com., soon takes bids sewers and appurtenances, $230,000. P.W.A. allotted $155,000 loan. A. Potter, 50 Church St., New York, engr.

**N. J., Ridgewood**—Village plans sewers and appurtenances. P.W.A. 153, $48,500, also for sewers and appurtenances, P.W.A. 152, $89,000. P.W.A. loan accepted by Council. R. A. Harton, 25 Hudson St., engr.

**N. J., Union**—Union Twp. soon takes bids sewerage system. $216,000. $190,000 loan allotted by P.W.A. A. Potter, 50 Church St., New York, engr.

**N. Y., Beacon**—See "Contracts Awarded."

**N. Y., Brocton**—Village making plans sewerage system and disposal plant. $134,000. P.W.A. project. Hill & Hill, North East, Pa., engrs. Noted Aug. 2.

**N. Y., Cedarhurst**—Municipality plans sewerage system. $643,000. P.W.A. funds allotted. C. W. McLaughlin, 266 Fulton St., Hempstead, engr. Noted Oct. 26.

**N. Y., East Rockaway**—Voted $140,000 for sewers.

**N. Y., Freeport**—Municipality plans sewage disposal plant addition. $185,000. P.W.A. funds allotted. Baldwin & Cornelius, Freeport, engrs. Noted July 12.

**N. Y., Highland**—Town of Lloyd plans sewers and disposal plant. $161,000. P.W.A. allotted funds. T. F. Bowe, 110 William St., New York, engr.

**N. Y., New York**—S. Levy, pres, Manhattan Boro, rejected bids Mar. 29, improving sewer on west side Central Park. Noted Mar. 22.

**N. Y., Port Chester**—Municipality plans sanitary sewers. $30,000. P.W.A. funds allotted. F. I. McGrath, 110 Willett Ave., engr. Noted Apr. 19.

**N. Y., Scarsdale**—Municipality plans sewers. $74,000. P.W.A. allotted funds. A. Boniface, Scarsdale, engr.

**N. Y., Schenectady**—Municipality plans by M. M. Cohn, 1727 Rugby Rd., and L. R. Purdy, 1125 Morningside Ave., incinerator. To exceed $50,000. P.W.A. funds allotted.

**O., Cleveland**—City bids this fall 14 mi. steel or c.i. pipe line from Easterly Sewage Treatment Plant at East 140th St., and Lake Erie to Southerly Sewage Disposal Plant at East 49th St. $750,000. G. B. Gascoigne, Leader Bldg., engr. P.W.A. loan granted.

**Okla., Ardmore**—City plans bond issue election for sewage disposal plant, auxiliary piping and sewer connections. $39,300. Awaiting final action by P.W.A. on application for grant and loan. S. P. Mathews, Ardmore, engr. Noted Dec. 28.

**Tex., Paris**—City, J. N. Crook, voted $70,000, for sewage disposal plant. Total $98,000. W. F. Hicks, Paris, engr.

**BIDS ASKED**

**Ind., Huntington**—City, Z. T. Dungan, mayor, bids about Aug. 18, sewage plant. P.W.A. project. C. Hurd, 1039 Architects Bldg., Indianapolis, engr. Noted Oct. 12.

**Ia., Oskaloosa**—City bids about Sept. 1, sewage disposal plant, auxiliary piping, connections, etc. $150,000. P.W.A. project. D. R. Russell, city engr. Noted Aug. 2.

**Md., Berlin**—Sept. 4, Mayor and City Council, complete sanitary sewerage system, consisting of 41,248 ft. 8 in. and 15 in. vitr. sewers, sewage treatment plant and pumping station. Remington, Vosbury & Goff, Camden, N. J., engrs. Noted Mar. 1.

**Mass., Canton**—Aug. 28, by Dpt. P. Welfare, C. Baylies, chn. Trustees Massachusetts Hospital School, Canton, 8,390 ft. 10- to 15-in. vitr. clay or concrete sewer line and appurtenances. $71,000. P.W.A. project. Whitman & Howard, 89 Broad St., Boston, engrs. Noted Feb. 8.

**Mich., Charlotte**—Aug. 27, by City Clerk, furnishing, installing equipment only for sewage disposal plant. $38,000. Grant of $11,500 allotted by P.W.A. Menefee & Dodge, Ann Arbor, engrs.

**Minn., St. Paul**—Sept. 5 (extended date), by Minneapolis-St. Paul Sanitary Dist., 1923 University Ave., constructing intercepting sewers, Contr. 105, Div. D., Job 400, $400,000; and dredging 170,000 cu.yd. in Mississippi River, Contr. 106A, Div. A, Jobs 100A and 11[illegible] $35,000. C. C. Wilbur, c/o owner, ch. [illegible] Noted Aug. 16.

**N. Y., Guilderland**—Sept. 4, by Commiss[illegible] Dpt. Health, State Office Bldg., Albany, constructing sewers and water lines in conne[illegible] with isolation building at State Laboratory [illegible]

**N. Y., Long Island City**—Aug. 30, by G. [illegible] Harvey, pres, Queens Boro, Queens Subway [illegible] sewers in Horace Harding, Junction and L[illegible] Blvds., 171st and Firwood Pls., 23rd, [illegible] Cooper, 91st, Baldwin, 107th, 114th, 11[illegible] 108th 109th, 114th, Murdock, Jamaica, 11[illegible] and Pitkin Aves., Gilmore, Eriesson, 102nd, 7[illegible] 172nd, 167th, 178th, 179th, 193rd, 1[illegible] 200th, Dunkirk, Wood, Hannibal and 95th St[illegible]

**N. Y., Orangeburg**—Aug. 29, by Commiss[illegible] Dpt. Mental Hygiene, State Office Bldg., Al[illegible] constructing sewers and waterlines at Rock[illegible] State Hospital.

**N. Y., Sonyea**—Aug. 29, by Dpt. Mental Hygiene, State Office Bldg., Albany, construct[illegible] sewer and water lines, at Craig Colony, P.W.A. project.

**O., Van Wert**—Aug. 29, by B. A. Welch, [illegible] P. Wks., Contr. 1, force mains and sewage treatment plant, 10,931 ft. 8- to 36-in. vitr. clay and 2,778 ft. 16-in. c.i. pipe. $50,995. Jennings-Lawrence Co., 12 North 3rd St., Columbus, engrs.

**Pa., Dauphin**—Aug. 27, by Boro Council, G. W. Shoop, secy., constructing 8,000 ft. terra cotta sewer. E. W. Cowden, Harrisburg, engr.

**Wash., Seattle**—Bd. P. Wks., City Hall, received bids August 2, for sewers, [illegible] sewers and appurtenances on Railroad Av[illegible] from Broad to Lenora Sts. Bids held unopened until certain matter pertaining to railroad properties are taken by Bd. P. Wks. Noted Aug. 2.

**Wis., Janeville**—Aug. 31, by M. A. Pu[illegible] city clk., sewage treatment plant. J. L[illegible] city engr.

**Wis., Milwaukee**—Aug. 30, by Sewer[illegible] Comn., structural steel railings, grating [illegible] extension to sewage purification plant, $40,000. P.W.A. project. D. W. Townsend, acting ch. engr.

**CONTRACTS AWARDED**

**Calif., Los Angeles**—Los Angeles Co. Sanitation Dist. 1, sewers part of Hooper Ave.-Compton Creek trunk sewer, involving 9,239 ft. 33 in. and 6,130 ft. 27 in. extra strength vitr. clay pipe, 17 standard manholes, 14 drop manholes, 15 junction chambers, etc., to Artukovich Bros. & Bebek & Brkich, 912 South Atlantic Blvd., Hynes, $128,730. **P.W.A.** Noted Aug. 16.

**Calif., San Francisco**—S. J. Hester, secy. Dpt. P. Wks., sewer in 6th St., to Eaton & Smith, 715 Ocean Ave., $133,921. Bids July [illegible] awarded Aug. 9.

**Minn., St. Paul**—City, constructing part of Sewer Interceptor C, to Walter Bitler Co., 620 Hamm Bldg., $60,000. **P.W.A.** Noted July 31 Daily.

**Minn., St. Paul**—Minneapolis-St. Paul Sanitary Dist., 1923 University Ave., Contr. 104, Div. E, Job 500, 5,000 ft. tunnel 11 ft. 9 in. inside diam. double elliptical section from Griggs St. and St. Anthony Ave. to Pierce St. and Roblyn Ave., also enlarging existing shaft at Hamline-St. Anthony Aves., to G. R. Cook Co., Penobscot Bldg., Detroit Mich., $456,350. **P.W.A.** Bids Aug. 6. Noted July 19.

**N. Y., Beacon**—City sewage disposal plant, day labor, $75,000. Will purchase all materials. Barker & Wheeler, 36 State St., Albany, engrs.

**N. Y., New York**—S. Levy, pres, Manhattan Boro, Municipal Bldg., altering and improving sewer in 12th Ave., to F. DiMicco, 1567 York Ave., $25,314. Bids June 18. Noted June 14.

**Tex., Fort Stockton**—City sanitary sewerage system, incl. 9 mi. 6- to 12-in. mains, Imhoff tank, sludge drying bed, to E. L. Dalton, Dallas Bank & Trust Bldg., Dallas, approximately $54,780. **P.W.A.**

## BRIDGES AND GRADE CROSSINGS

**PROPOSED WORK**

**Ill., Cairo** — Cairo Bridge Comn., c/o R. Williams, chn., 207 Bd. Trade Bldg., indefinitely postponed construction rein.-con., steel bridge over Ohio River, $2,500,000. Application pending for $2,005,000 P.W.A. grant and

†*Federal Government.*

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Bridges, etc. (Continued)

loan. **Modjeski, Masters & Chase**, Keystone Bldg., Harrisburg, Pa., engrs. Noted Feb. 1.

**N. Y., Jamestown**—Erie R.R. Co., G. S. Fanning, ch. engr., Midland Bldg., Cleveland, O., preparing revised plans eliminating main line crossing at Fairmount Ave. $200,000-$300,000. **Maturity early in 1935.**

**N. Y., Liberty**—New York, Ontario & Western R.R. Co., W. C. Heidenthal, ch. engr., Middletown, soon takes bids eliminating grade crossing, $94,000. Plans, specifications and cost approved by Public Service Comn. Noted Mar. 23, 1933.

**Pa., Jeannette**—Pennsylvania R.R. Co., Broad St. Station, Phila., T. J. Skillman, ch. engr., plans overhead bridge across right-of-way Harrison Ave. $99,000.

**Tenn., Nashville**—City making plans 17 spans 1,200 ft. deck girder viaduct at Demonbreum St. $193,000. Hart, Freeland & Roberts, Independent Life Bldg., engrs. P.W.A. project. Noted Aug. 9.

### BIDS ASKED

**†Florida**—Sept. 5, by U. S. Eng., Jacksonville, constructing 6 drainage culvert structures at Lake Okeechobee.

**Indiana**—Aug. 28, by J. D. Adams, chn. State Hy. Comn., Indianapolis, constructing bridges in Lake, Dearborn, Crawford, Spencer and Scott Counties.

**Iowa**—Aug. 28, by State Hy. Comn., Ames, constructing culverts on P.R. Rd. 2, NRM 250, Louisa Co.; bridge on P.R. 44, P-339, Pocahontas Co.; bridge and overhead crossing on NRH-NRM 280, U.S. Rd. 34, Pottawattamie Co.; culvert on U.S. Rd. 75, NRH-281, Sioux Co. F. R. White, ch. engr.

**Massachusetts**—Sept. 4, by Commonwealth of Massachusetts, Dpt. P. Wks., F. E. Lyman, comr., 100 Nashua St., Boston, superstructure for bridge over Saugus River between Lynn and Revere, incl. two 50 ft. structural steel shore spans, 8 spans about 100 ft. each, 1 rolling lift bascule type draw span, also about 1,650 ft. bituminous macadam and 1,011 ft. bituminous concrete type "D" approaches. Total est. approximately $1,000,000. J. R. Worcester & Co., 79 Milk St., Boston, consult. engrs. Noted Mar. 1 and Jan. 18.

**New York**—Sept. 13, by Triborough Bridge Authority, 111 8th Ave., New York, embankment, Grand Central Parkway extension, 96th St. to Northern Blvd. of Queens Connection, Triborough Bridge connecting Manhattan, Bronx and Queens Boros., Contr. 23.

**Pennsylvania**—Aug. 31, at office S. S. Lewis, secy. Hys., Harrisburg, 4,305 rein.-con. pedestrian underpass and retaining walls, 40 ft. wide, R-247, Sect. 3, City of Pittsburgh, Allegheny Co., involving 21,106 cu.yd. Class 1, 3,859 cu.yd. Class 2, 65,290 cu.yd. borrow excav. P.W.A. project; 45 ft. rein.-con. bridge, R-103, Bridge No. 16, Morris Twp., Greene Co.; 1,150 ft. through truss bridge, R-291, Sect. 4, Hillsgrove Twp., Sullivan Co.; 650 ft. through plate girder bridge, bituminous penetration Spec. P.M. 2 on native stone paving, R-103, Westfield Twp., Tioga Co.; 235 ft. rein.-con. bridge, native stone or modified broken stone base with bituminous surface course Spec. E paving, 16 to 23 ft. wide and variable for flare, R-519, Bridge No. 3, West Pike Twp., Washington Co.; bituminous surface course on plain concrete paving 1,401 ft. R-384, Sect. R-2, Blair Co., 1,456 cu.yd. Class 1 excav.

**Pa., Pittsburgh**—Aug. 28, by R. G. Woodside, controller Allegheny Co., Courthouse, removal of existing bridge and reconstructing bridge and approaches, Bridge 2, Piney Fork. E. L. Schmidt, 416 County Office Bldg., engr.

**Tennessee**—See "Streets and Roads."

**Tex., Dallas**—Sept. 11, by State Hy. Dpt., Austin, furnishing materials necessary for revising Union Terminal Co. Railway facilities in connection with Main, Elm, Commerce Street extension project, on Hy. I-b, N.R.M. 770-D, Contr. 2, $1,000,000. Noted Aug. 2.

### CONTRACTS AWARDED

**Md., Baltimore** — State and City, Federal Reserve Bank Bldg., constructing Bath Street Viaduct, 2,075 ft. long, to G. A. Fuller Co., Munsey Bldg., Wash., D. C., $894,400. **P.W.A.** Bids Aug. 10. Noted Aug. 14

**New Hampshire**—State Hy. Dpt., Concord, 3 span, 146 ft. rein.-con. T-beam bridge over Soucook River, Loudon, Merrimack Co., to Lane Constr. Corp., Colony St., Meriden, Conn., $23,479. Est. $30,000. Bids Aug. 9. Noted Aug. 2.

**N. J., Hoboken and Weehawken**—New York Central R.R. Co., J. W. Pfau, ch. engr., 466 Lexington Ave., New York, and Erie R.R. Co., G. S. Fanning, ch. engr., Midland Bldg., Cleveland, O., eliminating grade crossing, to G. A. Fuller Constr. Co., 597 Madison Ave., New York; 940 tons structural steel, to American Bridge Co., 71 Bway., New York. Est. $480,000. **P.W.A.** Noted May 10.

**N. Y., New York**—Triborough Bridge Authority, 111 8th Ave., cables and suspenders of Triborough Bridge connecting Manhattan, Bronx and Queens Boroughs, to American Bridge Co., 71 Bway., $792,669. **P.W.A.** Bids July 19. Noted July 12.

**Ohio**—See "Streets and Roads."

**O., Cincinnati**—City, City Hall, 2 span, 126 ft. steel, concrete bridge at Clifton Ave., to Hodges Constr. Co., 1051 Flint St., $62,400. Est. $64,900. Bids July 31. Noted Aug. 2.

**Rhode Island**—G. H. Henderson, ch. engr. State Bd. P. Roads, Providence, removing present timber bridge and constructing 2 span, rein.-con. slab bridge, 46 ft. long, 52 ft. wide, Newman Ave., East Providence, State Bridge 224, to Lee Constr. Co., Inc., 133 Southampton St., Roxbury, Mass., $25,332***removing portion of present bridge and constructing 1 rein.-con. slab bridge, 36 ft. long, 34 ft. wide, Johnsons Pond Bridge 334, Coventry, to Engineering Service & Constr. Co., 161 Devonshire St., Boston, Mass., $8,844***removing present timber and constructing 2 span, 55 ft. rein.-con. slab bridge, Bridgetown Bridge 344, Narragansett and South Kingston, to Seaboard Constr. Co., 434 Allens Ave., Providence, $31,585. Grand total $65,761.

## STREETS AND ROADS

### BIDS ASKED

**California**—Aug. 30, by C. H. Purcell, state hy. engr., State Bldg., Los Angeles, grading, oil treated crushed gravel surfacing 6.8 mi. state highway known as State Hy. Project "B", from point 1.5 mi. north of Moreno to 2.5 mi. west of Beaumont, Riverside Co. To exceed $17,750.

**Calif., San Leandro**—See "Contracts Awarded."

**†Georgia**—Aug. 31, by Pub. Rds., Dpt. Agriculture, at office Park Superintendent, New Post Office, Georgia Ave. between 9th and 10th Sts., Chattanooga, Tenn., constructing 7.18 mi. Ringgold Rd. from Chickamauga Park Boundary to Ringgold, Catoosa Co. H. J. Spelman, principal hy. engr.

**Iowa**—Aug. 28, by State Hy. Comn., Ames, concrete repaving 0.708 mi. U.S. Rd. 218 and P.R. 57, Cedar Falls, NRM-317, Black Hawk Co.; 0.253 mi. P.R. 60, NRM-444, Boone Co.; graveling 2.01 mi. road north of Belle Plaine, P861, Benton Co.; 1.843 mi. NRS-455, Clarke and Decatur Counties; grading 0.214 mi. P.R. 2, NRH 53; 0.536 mi. P.R. 2, Columbus Junction, NRM 250, both Louisa Co.; 1.96 mi. Rd. 34, out of Council Bluffs, NRH-NRM 280, Pottawattamie Co.; guard rail on U.S. Rd. 55, F-371-AB, Clayton Co.; 2nd course graveling P.R. 76, F-338, Louisiana and Muscatine Counties; P.R. 78, F-352, Henry and Louisa Counties; P.R. 213, P-808, Monroe and Wapello Counties; P.R. 160, P-802, Muscatine Co.; maintenance graveling 12.1 mi. M-158, Boone Co.; 65.8 mi. M-159, Calhoun Co.; 15.9 mi. M-160, Carrol Co.; 13.6 mi. M-161, Dallas Co.; 28.5 mi. M-162, Greene Co.; 8.5 mi. M-163, Hardin Co.; 7.5 mi. M-164, Jasper Co.; 7 mi. M-165, Marshall Co.; 9.1 mi. M-166, Polk Co.; 27.7 mi. M-167, Poweshiek Co.; 12.5 mi. M-168, Storey Co.; 14.4 mi. M-169, Tama Co.; 13.6 mi. M-170, Webster Co.; 14.7 mi. M-253, Bremer Co.; 11.8 mi. M-254, Fayette Co.; 13.2 mi. M-255, Kossuth Co.; 10 mi. M-256, Mitchell Co. F. R. White, ch. engr.

**Ia., Maregno**—See "Contracts Awarded."

**Maryland**—Aug. 28, by State Rd. Comn., Baltimore, concrete paving 0.92 mi. Berlin-Powellville Rd., Worcester Co.; macadam paving 2.27 mi. Corsica Neck Rd., Queen Anne Co. P.W.A. project.

**Mo., St. Louis**—Sept. 18, by Bd. P. Serv., City Hall, grading, new manholes, inlets and connections, concrete paving Carondelet Blvd. from Weber to Morganford Rds. $62,600. P.W.A. project. L. A. Pettus, city engr.

**New York**—Aug. 30, by Triborough Bridge Authority, 111 8th Ave., New York, grading, paving Eastern Blvd. between White Plains Rd. and Seabury Ave.; Eastern Ave. between Seabury Ave. and Middletown Rd.; paving Whitlock Ave. between Hunts Point and Longfellow Aves. and between Whitlock Ave. and White Plains Rd., all on Bronx Connection Triborough Bridge, connecting Manhattan, Bronx and Queens Boros.

**New York**—Sept. 5, by A. W. Brandt, comr., State Hy. Dpt., Albany, constructing roads in Oneida and Lewis Counties; reconstructing roads in Cattaraugus, Erie, Fulton, Hamilton, Jefferson, Nassau, Onondaga, Ontario, Rensselaer, Warren and Washington Counties.

**N. Y., Bath**—See "Contracts Awarded."

**N. Y., Brooklyn**—Aug. 29, by R. V. Ingersoll, pres. Brooklyn Boro. Boro Hall, grading, asphalt on concrete paving Flatbush Ave., Herkimer, India, Brighton 5th, Brighton 6th and Brighton 7th Sts., grading, curbing, flagging 24th Ave., East 23rd, East 40th, Wyona Sts.

**N. Y., Oneonta**—Sept. 11, by Commissioner Dpt. Health, State Office Bldg., Albany, constructing roads at State Tuberculosis Hospital.

**N. Y., Plattsburg**—Sept. 4, by Commissioner Dpt. Education, State Educ. Bldg., Albany, roads and walks at Plattsburg State Normal School.

**N. Y., St. George**—Aug. 29, by J. A. Palma, pres. Richmond Boro, Boro Hall, asphalt block paving Victory Blvd. from St. Marks Pl. to Jersey St.

**O., Columbus**—Aug. 29, by F. D. Donnally, clk. Franklin Co., grading, draining, bituminous macadam resurfacing 4.05 mi. Fisher Rd., 16 ft. $37,483. C. C. Lattimer, Court House, co. surv.

**O., Port Clinton**—Aug. 27, by Coms. Ottawa Co., concrete paving 11 mi. Bay Shore Rd., 18 ft., $22,000.

**†Pa., Gettysburg**—Aug. 30, by Pub. Rds., Dpt. Agriculture, 149 Winder Bldg., 17th and F Sts., N.W., Wash., D. C., constructing 2 road projects in Gettysburg Military Park. H. J. Spelman, principal hy. engr.

**Tennessee**—Sept. 7, by Dpt. Hys & P. Wks., Nashville, asphalt seal coat on 1.915 mi. State Hy. 6, between Howard Ave., Nashville, and National Cemetery, Davidson Co.; surfacing, 1 concrete culvert on State Hy. 52, between Route 41 and Portland, Sumner Co.; roadside development and landscaping 13.127 mi. State Hy. 35, Know, Blount and Sevier Counties; bridge and approaches over Obey River, State Hy. 3, Clay Co.; bridge and approaches at Hermitage Springs Hy. 58, Clay Co.

**Texas**—Sept. 11, at office of City Secretary of Dallas and at office of State Hy. Engineer, Austin, for state highway work. Projects N.R.H.-M. 770-C and D.

**Tex., Waco**—Sept. 4, by McLennan Co., W. C. Cobb, aud., grading, drainage, structures, concrete surfacing 8.394 mi. County Road. M. Hannah, Waco, engr.

**†Virginia**—Aug. 30, by Dpt. Agriculture, P. Rds., 419 Winder Bldg., 17th and F Sts., Wash., D. C., grading, constructing stone walls, bituminous surface treatment on macadam paving 1.22 mi. road at Monticello. Albemarle Co.

### CONTRACTS AWARDED

**†Arizona**—Pub. Rds., Phoenix, grading, draining 8.017 mi. road in Coconino Co., to Hodgeman & MacVicar, Pasadena, Calif., $104,067. Est. $109,378. Bids July 17.

**†California**—Superintendent Lighthouses, 424 Custom House, San Francisco, constructing 4 mi. roadway, extending from west end of suspension bridge over Mattole River, 1 mi. south of Petrolia, etc., Humboldt Co., to Mercer-Fraser Co., 2nd and Commercial Sts., Eureka, $25,250. Bids July 16, awarded Aug. 13.

**Calif., Sacramento**—W. H. Young, clk. Sacramento Co., 2 in. asphaltic macadam shoulder 24 ft. wide on Rio Linda Rd. and on Old Marysville Rd., to A. Teichert & Son, P. O. Box 1118, $1,515 and $1,585 respectively; asphaltic macadam paving Lower Stockton Rd., to J. R. Reeves, R.F.D. No. 3, Box 100, $10,555. Grand total $13,655. Bids Aug. 6, awarded Aug. 10.

**Calif., San Jose**—H. Pfister, co. clk. Santa Clara Co., 115,000 sq.ft. road oil treating Vista Rd., to A. J. Raisch, Burrell Bldg., $4,989. Bids Aug. 6, awarded Aug. 10. Noted Aug. 23.

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†*Federal Government.*

Streets and Roads (Continued)

**Calif., San Leandro**—City, E. F. Hutchings, clk., furnishing, spreading oil on streets for year ending June 30, 1935, own forces. No bids received Aug. 6.

**Colorado**—State Hy. Dpt., Denver, gravel surfacing and grading 13.816 mi. hy. between Pueblo and Walsenburg, Combined State Project 296-C, Div. 1 and 296-E, Div. 1, Pueblo and Huerfano Counties, to Driscoll Constr. Co., Pueblo, $28,926. Noted July 27 Daily.

**Ill., Carlinville**—Dpt. P. Wks. & Bldgs., Div. Hys., concrete paving 2.1872 mi. Sect. 2, 1-MFT in Bond. to Moore & Kreipke, 2000 St. Clair Ave., East St. Louis, $44,470; rein.-con. box culvert, Sect. J-B15D, to M. C. Robinson, Girard, $623. Bids Aug. 7. Noted Aug. 2.

**Ill., Chicago**—Cook Co., constructing culverts and extension, near Winnetka and near Bensonville, to Vanetten Bros. Builders, 11024 Michigan Ave., $4,244 and $3,932 respectively*** 1.015² mi. 40 ft. pavement near Chicago, to G. H. Summerville, Harvey, $100,002***1.8385 mi. 40 ft. pavement near Niles Center, to Krenn & Dato Constr. Co., 228 North LaSalle St., $127,559. Grand total $235,736. Bids June 5.

**Ill., Chicago** — Cook Co., concrete paving 0.5468 mi. road, 46 ft. wide, to Arcole Constr. Co., 228 North LaSalle St., $64,638. Bids June 5.

**Ill., Danville**—Dpt. P. Wks. & Bldgs., Div. Hys., concrete paving 3.0392 mi. road in Vermilion Co., to L. B. Dyer Constr. Co., Hoopeston, $52,580.

**Ill., Tuscola**—Dpt. P. Wks. & Bldgs., Div. Hys., concrete paving 1.8156 mi. road, 9 ft., near Broadlands, Douglas Co., to Thornton & Sons, Mattoon, $22,825. Bids July 27.

**Indiana**—State, Hy Comn., Indianapolis, bitum. mulch-emulsified asphalt paving 2.058 mi. Tippecanoe Co., to D. E. Fauber, West Lafayette, $47,881, est. $63,075***grading, concrete structures 5.1 mi. Morgan and Hendricks Counties, to Goodwin & Harvey, Danville, $7,301, est. $7,705***bitum. mulch-liquid asphalt paving 5.892 mi. Brown Co., to L. P. Cavett Co., Lockland, O., $14,061, est. $20,693. Grand total $69,243. Bids July 31. Noted July 20.

**Indiana**—State Hy. Comn., Indianapolis, concrete structures 10.01 mi. Grant Co., to Miles & Wilkins, Marion, $6,805 est. $7,581***23.05 mi. LaPorte and St. Joseph Counties, to A. W. Taylor, LaPorte, $10,179 est. $11,917***12.7 mi. Starke Co., to E. T. Strom, Gary, $13,256 est. $14,859. Grand total $30,241. **P.W.A.** Bids July 31. Noted July 26.

**Indiana**—State Hy. Comn., Indianapolis, bituminous concrete paving 0.715 mi. road, 36-46 ft. wide, in Kosciusko Co., to Gast Constr. Co., Warsaw, $29,740. Est. $34,702. **P.W.A.** Bids Apr. 24. Noted Apr. 19.

**Ia., Marengo**—Iowa Co., grading 6.99 mi. trunk road, incl. 71,390 cu.yd. excav., day labor. Bids Aug. 1 rejected. W. K. Chantry, co. engr.

**Kentucky** — State Hy. Comn., Frankfort, gravel surfacing 10.113 mi. Chavies-Buckhorn Rd., Perry Co., to H. H. Miller Constr. Co., Jackson, $51,062.

**Maryland**—State Roads Comn., Baltimore, sheet asphalt paving 1.15 mi. Pennington Ave. from Cabin Branch to Arundel Cove Ave., Contr. BC-135-1-72, Federal Aid Project N.R.M. 240-C, Baltimore City, to National Paving & Constr. Co., Menlo Dr. and Western Maryland R.R., Baltimore, $73,615***concrete paving 2.45 mi. Southern Maryland Blvd., Contr. C-79-188, Calvert Co., to L. R. Colbert, Fredericksburg, Va., $60,577***concrete paving 0.3 mi. Takoma Ave., Takoma Park, Contr. M-271-2-38, Montgomery Co., to P. Reddington & Sons, 2 East Lexington St., Baltimore, $12,776. Grand total $146,968. **P.W.A.** Noted July 26.

**Maryland**—State Rds. Comn., Baltimore, grading, draining 1.61 mi. Harford Co., to H. T. Campbell & Sons, Towson, $93,254***concrete paving and header with bituminous surface course 1.5 mi. in Cecil Co., to Thomas, Bennett & Hunter, Westminister, $36,253. **P.W.A.** Bids July 31. Noted July 26.

**†Md., Aberdeen**—Con. Q. M., roads, sidewalks, gutters, at U. S. Proving Ground, to J. A. Lavezza, 310 South Exeter St., Baltimore, $94,000. Noted July 26.

**New Hampshire**—State Hy. Dpt., Concord, 3 in. bituminous macadam on 4 in. broken stone and on 6 in. gravel paving 2.37 mi. Whittier Rd., Meredith, Belknap Co., to Carlo Bianchi

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& Co., Inc., Framingham, Mass., $51,229 est. $80,000; 3 in. bituminous macadam on 5 in. broken stone and on 6 in. gravel paving 2.348 mi. Dartmouth College Rd., Winchester, Cheshire Co., to Arborio Road Constr. Co., Wilson, Conn., $63,694 est. $80,000.

**N. J., Phillipsburg**—City Comrs., concrete paving South Main St. from Market to Stockton Sts., to Korp & Korp, Phillipsburg, $32,968. Bids Aug. 6.

**N. J., Rockaway**—Rockaway Twp. Com., concrete paving Rockaway-Green Point Rd., to Gray Constr. Co., Morristown, $34,611.

**N. Y., Bath**—Steuben Co., improving highways in 9 townships, day labor, under supervision County Hy. Dpt. $36,825.

**N. Y., New York**—S. Levy, pres. Manhattan Boro, Municipal Bldg., sheet asphalt paving East 136th and East 131st Sts., to Bronx Asphalt Corp., Edgewater Rd. and Lafayette Ave., $7,968 and $7,473 respectively***West 81st St., to Highway Impvt. & Repair Co., Fumans Island, Brooklyn, $5,731***West 90th St., to Venetian Contg. Co., 2 Lafayette St., $7,889***asphalt block paving West 130th St., to E. T. Barry, 126-06 139th Ave., West 130th St. $10,065*** granite block pavink West 18th St., to Walthaw Corp., 1860 Bway., $38,390***Prince St., to Agmac Co., 15 Park Row, $28,215. Grand total $105,731. Bids July 6. Noted June 28.

**N. Y., New York**—S. Levy, pres. Manhattan Boro, Municipal Bldg., granite block paving Lafayette St., to W. J. Fitzgerald, Grand Central Terminal, $56,889. Noted June 28.

**N. Y., New York**—S. Levy, pres. Manhattan Boro, Municipal Bldg., paving Park Ave., to Venetian Contg. Co., 2 Lafayette St., $9,195 ***28th St., to Highway Impvt. & Repair Co., 50 Church St., $12,638***granite block paving West Houston St., to Walthaw Corp., 1860 Bway., $14,708***West 30th St. and 2nd Ave., to Agmac Corp., Inc., 1860 Bway., $22,163 and $11,462 respectively. Grand total $70,166. Bids June 27. Noted June 21.

**N. Y., New York**—S. Levy, pres. Manhattan Boro, Municipal Bldg., asphalt repaving Cathedral Parkway, to C. D. Beckwith, Inc., Seneca Ave. and Edgewater Rd., $12,154***7th Ave., to Meehan Paving & Constr. Co., 90 West St., $188,975***granite paving North Moore St., to E. T. Barry, Inc., 126-06 139th Ave., Laurelton, $5,620. Grand total $206,749. Bids July 24. Noted July 19.

**N. Y., Rome**—City, improving South James St., to Warren Bros. Roads Co., 38 Memorial Dr., Cambridge, Mass., $64,517. **P.W.A.** Bids July 17.

**N. Y., Tarrytown**—Hy. Impvts., Greenburgh Bd. Room, Lyceum Bldg., North Bway. and Central Ave., improving Sheldon Ave., to Amoriello & Sons, Inc., 102 Washington Pl., North White Plains, $23,881. **P.W.A.** Bids June 28.

**Ohio**—O. W. Merrell, dir. Hys., Columbus, traffic bound macadam surface course paving 1.072 mi. Sects. "H" and "Hemlock" (part) Shawnee-Corning Rd. and constructing creosoted timber bridge with steel stringers, 49-ft. span, over west branch of Sunday Creek, to Beighler & Hussey, 1355 Wyandot Rd., Columbus, $44,448; concrete paving 0.263 mi. Sect. "N" and "Mt. Sterling" (part) Columbus-Washington C.H. Rd., to George B. Herring & Son, 419 Third St., Mansfield, $9,353.

**O., Circleville**—Pickaway Co., oil treatment 32.41 mi. county roads, 18 and 20 ft., to T. D. Van Camp Co., 55 East State St., Columbus, $39,975.

**Pennsylvania** — Dpt. Hys., Harrisburg, grading, rein.-con. bridge 1.46 mi. Route 331, Duboistown Boro, Lycoming Co., to Graham Constr. Co., 261 Woolworth Bldg., Lancaster, $24,743***grading approaches and 2 rein.-con. bridges Route 227, Sects. 1 and 2, Herrick and Gibson Twps., Susquehanna Co., to Tyler & Cole Mashoppen, $13,997***2 rein.-con. bridges Sects. 1-A and 1-B, Jefferson Twp., Lackawanna Co., to C. L. Camp, 635 North Irving Ave., Scranton, $7,887. Grand total $46,627. Noted July 19.

**Tex., Houston**—Dpt. P. Wks., emulsified asphalt and concrete widening Leeland Ave., from Caroline and Dowling Sts., to Brown & Root, Inc., 4300 Calhoun Rd., $29,045.

**Wisconsin**—State Hy. Comn., Madison, concrete paving 6.174 mi. U.S. Hy. 51, Stoughton-Madison-Portage Rd., Columbia Co., to W. Conway, 2105 Jefferson St., Madison, $92,905. **P.W.A.** Bids Aug. 10. Noted Aug. 2.

**Wisconsin** — State Hy. Comn., Milwaukee, grading, draining 14.163 mi. road in Vilas and Forest Counties, to Dixon Constr. Co., Albany, $61,509. **P.W.A.**; applying 220,000 gal. bitumen in Florence Co., to Barrett Co., 2800 South Sacramento Ave., Chicago, Ill., $2,250. Bids July 11. Noted July 5.

**Wisconsin** — State Hy. Comn., Ma[illegible] grading, draining, 4.81 mi. Door Co., to J. Bloomer, Appleton, $15,145***1.641 mi. Co. and 7.175 mi. Crawford Co., to J. Lathers, Beloit, $4,286 and $12,915 respect ***bituminous foot path projects in Milwa Co., to Singer Bros., 3770 North Humboldt Milwaukee, $11,160***0.238 mi. concrete paths in Milwaukee Co., to Gumz-Switalski 2065 South 18th St., Milwaukee, $1 Grand total $44,694. **P.W.A.** Bids Aug. Noted Aug. 2.

**†Wyo., Sheridan**—Vet. Bu., Arlington Wash., D. C., resurfacing roads, to Northwe Eng. Co., Rapid City, S. D., $26,500. July 10. Noted July 5.

## EARTHWORK, IRRIGATION DRAINAGE AND WATERWAYS

### PROPOSED WORK

**†Mich., Grand Haven**—U. S. Eng. pre nary plans and surveys made harbor impro ments, incl. 400 ft. wide and 21 ft. deep nel. from present pier to Grand Trunk R bridge at Ferrysburg, also turning basins South channel to 3rd St. bridge, $250,000

**Mont., Forsyth**—Cartersville Irrigation plans improving irrigation system, $81,0 P.W.A. funds allotted. C. L. Campbell, Forsyt consult. engr.

**Mont., Fort Belknap**—Fort Belknap Irri tion Dist. plans improving and new const tion irrigation system, $335,000. P.W.A. granted.

**N. M., Carlsbad**—Carlsbad Irrigation Dist C. W. Beeman, pres., election Aug. 31, $2,250, 000 to secure P.W.A. loan funds to constr dam to impound 100,000 acre-ft. on Pecos Riv also repairing irrigation ditches and laterals

**†O., Conneaut**—U. S. Eng., Buffalo, N. Y plans dredging deep water channel from L Erie to new municipal marine dock now u construction, Conneaut Harbor, $300,000.

### BIDS ASKED

**†California**—Aug. 31, by U. S. Eng., Post Office Bldg., Sacramento, constructing Butte Slough culvert type outfall gates, for passage of flood waters from Butte Basin to Sacramento River, 3.75 mi. downstream from Colusa, incl. 55,000 cu.yd. common excav.

**†Conn., Norwich**—Sept. 5, by U. S. Eng., Providence, R. I., dredging 135,000 cu.yd. in Norwalk Harbor. Noted May 31.

**†Iowa**—Sept. 11, by U. S. Eng., Rock Island, Ill., excavating and disposal of material in channel of Pool 20, Mississippi River, near Keokuk, Lock 19.

**†Mich., Fort Huron**—Aug. 30, by U. S. Eng., Detroit, dredging 12,000 cu.yd. material from Upper Black River and settling basin in Black River.

**Minn., St. Paul**—See "Sewerage and Waste Disposal."

**†O., Sandusky**—Aug. 29, by U. S. Eng., Buffalo, N. Y., dredging 145,000 cu.yd. material other than ledge rock from dock channel at Sandusky Harbor.

**†Tenn., Memphis**—Aug. 31, by U. S. Eng., 2,720,000 cu.yd. earthwork in White River Levee Dist.

**†Texas**—Sept. 10, by U. S. Eng., Galveston, dredging 1,780,000 cu.yd. in channel from Galveston Harbor to Texas City.

**†W. Va., Grafton**—U. S. Engg, Pittsburgh, Pa., bids about Oct. 15, constructing Tygart River Reservoir Dam, near here, incl. 274,000 cu.yd. common and 68,000 cu.yd. rock excav. Noted Aug. 2.

### CONTRACTS AWARDED

**†Ariz., Yuma**—W. E. Callahan Constr. Co., Arcade Bldg., St. Louis, Mo., H. Gunter & J. P. Shirley, Dallas, Tex., general contractors, 6,100,000 cu.yd. common excav. for All American Canal, for Bureau Reclamation, to J. H. Boyd & Sons and R. L. Igo, P. O. Box 1179, Baton Rouge, La., at 12.73c. per cu.yd., total $775,000. Noted June 28, under "Contracts Awarded."

**†California**—U. S. Eng., Post Office, Sacramento, raising and strengthening levee and constructing new levee on south bank of American River, from Western Pacific R.R. to east boundary Meister Tract, a distance of 2.3 mi., to Kuhn Bros., Inc., 408 Center St., Manhattan Beach, 18c. per cu.yd., total $62,820. Bids July 30, awarded Aug. 14.

*†Federal Government.*

Earthwork, etc. (Continued)

**Calif., Los Angeles**—City, furnishing Bureau Constr., all labor and material for fabricating and erecting one 300,000 gal. steel tank, 43 ft. diam., 29 ft. 3½ in. high, for irrigation system at Griffith Park. Spec. 3342. to Western Pipe & Steel Co., 5717 Santa Fe Ave., $3,282. Awarded Aug. 14.

**†Louisiana**—U. S. Eng., New Orleans, 160,000 cu.yd. levee in Tensas Levee Dist., to Valley Constr. Co., Vidalia, $69,920. Bids July 7.

**†Missouri**—U. S. Eng., Kansas City, constructing 3,160 ft. dikes in Missouri River at Bonneville Bend Reach, to Morrison Glascock Conor Co., Kansas City, $55,324. Bids Aug. 3.

**†Missouri**—U. S. Eng., Kansas City, constructing dikes and revetment and abatis in Missouri River at Rulo Bend to Squaw Bend, to Addison Miller, Inc., 1111 Builders Exch. Bldg., St. Paul, Minn., $719,154***dikes and revetment at Nemaha Reach to White Cloud Bend, to Woods Bros. Constr. Co., Lincoln, Neb., $567,284***and at White Cloud and Tarkio Bends, to Bilhorn Bowers & Peters, Inc., Railway Exch. Bldg., St. Louis, $568,521. Grand, total $1,854,959. Bids Aug. 7. Noted Aug. 2.

**†Missouri**—U. S. Eng., Kansas City, pile dikes and revetment work in Missouri River at Indian Cove Bend to Cotter Bend, to Wood Bros. Constr. Co., Lincoln, Neb., $1,659,410. Bids Aug. 7. Noted Aug. 2.

**Nebraska** — Platte Valley Public Power & Irrigation Dist., North Platte, 2,300,000 cu.yd. dirt dam and dikes, 40,000 cu.yd. concrete facing, inlet and outlet structures for Sutherland Reservoir, to C. F. Lytle & Western Asphalt Paving Co., Sioux City, Ia., $711,528. Est. $1,000,000. **P.W.A.** Bids Aug. 16. Noted Aug. 2.

**New Hampshire**—At office State Hy. Comn., Concord, stone jetties, sand dikes, hydraulic fill in Hampton River, involving 18,600 tons heavy quarry grout, 4,500 tons stone chips, 8,600 tons rip rap, 2,850 cu.yd. crushed stone or coarse gravel, to Merritt-Chapman & Scott Corp., 17 Battery Pl., New York, $294,043.

**†Oregon-Idaho**—Bureau Reclamation, Ontario, Ore., constructing earthwork, tunnel, structures, Kingman Lateral and Sub-laterals KL-9.3 to KL-10.0, Mitchell Butte Division, Owyhee Project, near Adrian, to Morrison-Knudson Co., Boise, Idaho, $88,939. Bids July 12. Noted June 28.

**Ont., Midland** — Secretary Dpt. P. Wks., Ottawa, constructing piers and floats, to Russell Constr. Co. Ltd., Harbour Comn. Bldg., Toronto, $89,943. Est. $120,000. Noted Aug. 2.

**Ont., Port Hope**—Secretary Dpt. P. Wks., Ottawa, constructing wharf extension, to Hill & Sibbald Ltd., Merriton, $22,700. Est. $30,000.

**Que., Grande Riviere**—Secretary Dpt. P. Wks., Ottawa, Ont., constructing open face cribwork jetty, to W. D. Backley & A. J. Urquhart, Barachois W., $27,170. Est. $64,000.

### FEDERAL POWER COMMISSION

Applications for Licenses and Permits
Licenses

1277 — W. I. Nelson and J. W. McKay, Crescent Mills, Calif., wants license for constructed power plant on Deadwood Creek, in Plumas Co., Calif.

1278—Nantahala Power & Light Co., Bryson, N. C., wants license constructed transmission line in Macon Co., N. C., affecting lands in Nantahala Natl. Forest.

1279—Pacific Gas & Electric Co., 245 Market St., San Francisco, wants license constructed transmission line in Sierra and Nevada Counties in Calif.

1280—Red Bluff Water Power Control Dist., Pecos, Tex., wants license, power project on Pecos River in Reeves and Loving Counties, Tex.

1281—C. C. Tillotson, 110 North 11th Ave., Phoenix, Ariz., preliminary permit power project on Colorado River in Coconino Co., Ariz., affecting lands in Kaibab Natl. Forest and Grand Canyon Natl. Game Preserve and Navajo Indian Reservation.

1282—Los Angeles, Calif.—City of Los Angeles, Dpt. Water & Power, wants license storage project on Mill, Leevining, Parker, and Rush Creeks, Mono Co.

1283—B. W. Teyres, Stayton, Ore., wants license constructed power project on unnamed stream in Marion Co.

*†Federal Government.*

1284—J. H. Bruff, Star Clothing Bldg., Yakima, Wash., wants license constructed power plant on Telephone Creek, in Kittitas Co.

## UNCLASSIFIED

### PROPOSED WORK

**California**—PIPE LINE, etc.—Standard Oil Co. of Calif., Standard Oil Bldg., San Francisco, making plans 108 mi. 12 in. steel pipe line connecting oil fields of San Joaquin Valley with marine terminal at Estero Bay in San Luis Obispo Co., near Bakersfield, incl. 7 pumping stations, storage reservoir, several steel storage tanks, pumphouse, pumping equipment. Company probably will let contract for part work. Construction expected to start Sept. 1. $4,000,000. H. H. Hall, Standard Oil Bldg., San Francisco, engr. Noted Aug. 16.

**Calif., Los Angeles**—ELECTRICAL SYSTEM—Dpt. Water & Power, 207 South Bway., plans improving electric system, incl. distribution station and equipment, $133,000; additions and betterments to existing stations $152,000; improving 33,000 volt overhead system $10,000; overhead low voltage system $60,000; underground system $45,000; replacing oil circuit breakers at Industrial Station $39,000.

**Conn., New Britain**—SUBWAY—City, Bd. P. Wks., City Hall, making plans constructing subway on Black Rock Ave., $61,710. Federal share $20,771, balance by city. G. J. Moelleur, City Hall, engr.

**Ind., Indianapolis** — SWIMMING POOL — Riley Hospital, plans therapeutic pool, brick, hollow tile, rein.-con., for children at James Whitcomb Riley Hospital, 700 Wilson St., $40,000. R. F. Daggett, 922 Continental Bank Bldg., Indianapolis, engr.

**Ia., Harlan**—SWIMMING POOL—City defeated $25,000 bonds, constructing 70x100 ft. rein.-con. swimming pool in Potter Park. Will resubmit to voters at early date.

**Me., Bath**—DOCKS and SHIPBUILDING—Texas Steamship Co. plans repairing docks and shipbuilding, $30,000 or more. **Maturity indefinite.**

**Mich., Bay City**—TANKS, etc.—Thiesen-Clemens Co., St. Joseph, plans 3 steel tanks and pumping equipment, $75,000. W. J. Shortell, St. Joseph, engr.

**Miss., Canton** — GAS SYSTEM — City made plans constructing municipal gas line and distribution system, $170,000. Awaiting approval of P.W.A. Black & Veatch, 700 Mutual Bldg., Kansas City, Mo., engrs. Noted June 28.

**†Mo., Jefferson Barracks**—STEAM LINES—Vet. Bu., Arlington Bldg., Wash., D. C., rejected bids June 29, replacing steam and return lines at Veterans Administration Facility.

**N. Y., Brooklyn**—SWIMMING POOL—Dpt. Parks, Arsenal Bldg., Central Park, New York, plans by A. Embury., c/o owner, swimming pool at Knickerbocker, Willoughby Aves., $40,000 or more. **Maturity later.**

**N. Y., College Point**—SWIMMING POOL—Dpt. Parks, Arsenal Bldg., Central Park, New York, preliminary plans by A. Embury, c/o owner, swimming pool, Chisholm Park, $40,000.

**N. Y., Flushing**—SWIMMING POOL—Dpt. Parks, Arsenal Bldg., Central Park, New York, plans by A. Embury, c/o owner, swimming pool, Kissena Park, North Hempstead Turnpike. Est. about $40,000.

**N. Y., New York** — PLATFORM EXTENSONS—Interborough Rapid Transit Co., 165 Bway., New York, plans extending subway platforms on White Plains Ave. Line, incl. Jackson, Prospect and Intervale Aves., and Freeman, 174th and 177th Sts. stations, $82,000. Private plans.

**N. Y., New York**—SWIMMING POOL—Dpt. Parks, Arsenal Bldg., Central Park, plans swimming pool, 5th Ave. and 122nd St. at Mount Morris Park, $40,000.

**N. Y., New York**—SWIMMING POOL—Dpt. Parks, Arsenal Bldg., Central Park, plans by A. Embury, c/o owner, swimming pool, Crotona Park, Fulton Ave. and 173rd St. Est. about $40,000.

**O., St. Clairsville**—GAS SYSTEM—Barnesville Development Co., Barnesville, plans natural gas distributing system. To exceed $50,000.

**Pa., New Castle** — TUNNEL — City and Lawrence Co. plan vehicular tunnel from Grant St. through North Hill to Whites Hollow, $1,000,000. P.W.A. project. Engineer not appointed.

**R. I., Warwick**—AIRPLANE RUNWAYS—State of Rhode Island, R. J. McMahon, 210 Main St., Pawtucket, bids in January constructing concrete runways and drainage system at State Airport, $450,000. A. P. Tolaferro, Jr. Co., 101 Park Ave., New York, and E. H. Faile, 441 Lexington Ave., New York, engrs.

**Wash., Seattle**—CAR TRACKS—R. P. Wks., plans reconstructing street car tracks on White Center St. destroyed by floods last winter, $73,000.

**Alta., Edmonton**—AIR CLEANING PLANT—Cadomian Coal Co., plans air cleaning plant (coal mines), $28,000 with equipment.

### BIDS ASKED

**Md., Baltimore**—PIPE LINE—United Industrial Alcohol Co., Curtis Bay, taking bids driving piles, concrete footings and structural steel for 12 in. steam pipe line 2.5 mi. long. A. Murray, New York, engr.

**N. Y., New York**—PIER SHED, etc.—Sept. 5, by Dpt. Docks, Pier A, foot Battery Pl., North River, constructing pier shed and bulkhead shed for Pier New 32, Canal St., North River, Manhattan Boro. Contr. 2068. Noted May 17.

**N. Y., New York**—TUNNEL—Aug. 31, by Port of New York Authority, 111 8th Ave., New York, demolition and removing buildings on site of New York approach of Midtown Hudson Tunnel between Wehawken, N. J., and Manhattan, N. Y.

**†Oregon**—RAILWAY—Aug. 31, by U. S. Eng., Portland, rebuilding Oregon-Washington Railway & Navigation Co. track at Bonneville Dam, incl. 9,000 ft. tunnel, 1,250,000 cu.yd. rip rap, $1,000,000.

**Tex., Kyle**—NATURAL GAS SYSTEM—See "Contracts Awarded."

**Wash., Seattle**—TRANSMISSION LINE—See "Contracts Awarded."

### CONTRACTS AWARDED

**†Kan., Fort Leavenworth**—HANGARS—Con. Q. M., constructing, completing alterations and repairing hangars, here, to Morley Eng. & Contg. Co., 1643 Belleview Ave., Kansas City, Mo., $21,266. Bids Aug. 3.

**La., New Orleans**—RAILROAD ROADBED—Public Belt Railroad Comn., Municipal Bldg., constructing roadbed to subgrade for extension of Public Belt R.R. from Protection Levee to beginning of earth approach to Mississippi River Bridge in Jefferson Parish, to L. G. Villere, 100 South Claiborne Ave., $30,101. Bids July 30, awarded Aug. 10.

**Mo., St. Louis**—WADING POOLS—Bd. P. Serv., City Hall, nine 31x52 ft. and one 21x42 ft., rein.-con. wading pools surrounded by sidewalks, to Smith-Cooke Constr. Co., 4829 Easton Ave., $20,540***altering Union Market building to enlarge bus terminal, to G. Moeller Constr. Co., 3520 Itaska St., $57,917***passenger elevator relocation, to W. A. Miller Machine & Elevator Co., 920 North Main St., $1,126. Grand total $79,583. **PWA.** Bids July 31. Noted July 12.

**Mont., Blackfoot**—RAILROAD—Chicago, Milwaukee, St. Paul & Pacific R.R. Co., C. F. Loweth, ch. engr., Union Station, Chicago, Ill., constructing 15 mi. branch line between Sunset and Cottonwood in Blackfoot Valley, to C. and F. Teaming Co., Butte.

**N. Y., Albany**—TRANSIT SHED—H. J. Blessing, general contractor, 1439 Western Ave., 400 tons structural steel for transit shed, to Leach Steel Co., 80 Steel St., Rochester, for Albany Port Comn.

**†Okla., Fort Sill**—FENCE—Con. Q.M., chain link fence for ordnance magazine area, to Continental Fence Co., 2835 South Lamar St., Dallas, Tex., $6,036. Bids July 31. Noted Aug. 2.

**Tex., Kyle** — NATURAL GAS SYSTEM — Southern Gas Utilities Co., Inc., Houston and San Antonio, natural gas distribution system, incl. 16,000 ft. 2- to 6-in. pipe, probably booster station, day labor, $30,000. Fifty year franchise granted.

**Wash., Seattle**—TRANSMISSION LINE—City Council, J. D. Ross, supt., constructing 7 mi. transmission line from Diablo to Gorge at Skagit River, day labor. Noted June 28, under "Public Buildings."

**Que., Three Rivers**—TRANSIT SHEDS—Dpt. Marine, Ottawa, Ont., constructing transit sheds, new wharves, reconstructing old wooden wharves, railway tracks and lighting system, to J. P. Porter & Sons Ltd., 1010 St. Catharines St. E., Montreal, $369,078. Est. $400,000.

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# MATERIALS AND EQUIPMENT

## PROPOSED WORK

DUMP TRUCK and TRACTOR—**Lakeport, Calif.** — Lake Co. plans purchasing 14 yd. hydraulic dump truck and one used 35 hp. tractor with trail builder.

FIRE ENGINE — **Salinas, Calif.** — Monterey Co. will form county fire protection dist. and purchase motor fire engine. To exceed $1,000.

TANK—**New Haven, Conn.**—Walter H. Goodrich & Co., Inc., 200 Waterfront St., plans 115 ft. diam. steel tank, 80,000 bbl. capacity. Private plans.

METAL STREET SIGNS—**Chicago, Ill.**—Dpt. P. Wks., City Hall, rejected bids July 3, furnishing, erecting 46,000 enameled metal street signs. $18,400. Noted June 28.

CULVERT PIPE—**Cedar Rapids, Ia.**—Linn Co., cancelled bids to have been opened Aug. 10, for 450 lin. ft. culvert pipe. Noted Aug. 9.

TANKS, etc.—**St. Louis, Mo.**—A. B. Lentz, 7103 South Bway., applied for permit to install two 500 gal. underground tanks for gasoline and 2 pumps, etc., for automobile service station at 7103 South Bway.

SNOW FENCE, etc.—**Batavia, N. Y.**—Bd. Supervs. Genesee Co. soon takes bids 20,000-25,000 ft. snow fence and posts. S. Wilford, Elba, engr.

MOTOR GRADERS, etc.—**Raleigh, N. C.**—Div. Purchase & Constr., A. S. Brower, dir., rejected bids opened Aug. 9, 20 motor graders, $50,000, also fifty 1½ cu.yd. dump bodies. Will readvertise.

TRUCKS and SNOW PLOWS—**Ottawa, Ont.**—Secretary Bd. Control, soon takes bids 3 trucks with snow plow attachment and scarifiers for ice, $22,000. F. C. Askwith, Ottawa, engr.

## BIDS ASKED

LIGHTNING ARRESTERS — **Los Angeles, Calif.**—Sept. 4, by D. P. Nicklin, city purch. agt., 707 South Bway., furnishing, delivering 15 lightning arresters, having rating of 37.5 kv. (a) f.o.b. cars, bidder's shipping point, (b) f.o.b. cars or trucks, 1630 North Main St. (c) f.o.b. cars or trucks, Lone Pine. Spec. No. 1482. To exceed $2,000.

COARSE AGGREGATE, etc.—**Chebanse, Ill.**—Aug. 30, by Dpt. P. Wks. & Bldgs., Div. Hys., 76 tons coarse aggregate and 58 T. fine aggregate for concrete paving; 107 bbl. portland cement, Chebanse Co.

CRUSHED AGGREGATE, etc. — **Indiana** — Aug. 29, by J. D. Adams, chn. State Hy. Comn., Indianapolis, 400-500 tons crushed aggregate, gravel or slag, f.o.b. Shelby; 400-500 tons, State Rd. 55; 400-500 tons, at Mount Ayr; 400-500 tons, at Foresman; 400-500 tons, State Rd. 55; 400-500 tons, on State Rd. 10; 300-500 tons aggregate 4 in trucks at plant, Marengo; 1,000 wood guide posts on roads in Aurora Sub-district.

GUIDE POSTS, etc.—**Indiana**—Aug. 28, by J. D. Adams, chn. State Hy. Comn., Indianapolis, 600-800 wood guide posts f.o.b. Indianapolis; 250-1,000 tons crushed aggregate or gravel f.o.b. Kirklin; 1,000 tons No. 6 gravel shipped to Lafayette.

LIMESTONE, etc.—**Washington, Ind.**—Aug. 27, by City, T. C. Medcalfe, clk., 4,200 cu.yd. crushed limestone, 2,700 cu.yd. fine aggregate; 7,200 bbl. portland cement; 3,916 ft. 6- to 24-in. vitr. clay pipe, etc.

†WINCHES, etc.—**Annapolis, Md.**—Aug. 29, by Yards & Docks, Navy Dpt., Wash., D. C., winches and electrical distribution system at Naval Academy, Spec. 7735.

†COPPER TUBING, etc.—**Boston, Mass.**—Aug. 28, by Bureau Supplies & Accounts, Navy Dpt., Wash., D. C., supplying copper tubing, steel bars.

†DIAPHRAGMS, SILICA BRICKS, etc.—**Boston, Mass.**—Aug. 31, by Supply Officer, Boston, or Bureau Supplies, Wash., D. C., diaphragms, silica bricks, turbine nozzles, cast steel chain.

TRUCK—**Winona, Minn.**—Sept. 11, by A. Baeuerlen, aud. Winona Co., one 3 ton truck.

†STRUCTURAL STEEL ANGLES—**Vicksburg, Miss.**—Aug. 28, by U. S. Eng., P. O. Box 667, structural steel angles.

†COARSE AGGREGATE, etc. — **Montana** —Aug. 30, by U. S. Eng., Kansas City, Mo., 260,000 cu.yd. coarse aggregate and 235,000 tons sand for Fort Peck Tunnel.

†CABLE, etc.—**Brooklyn, N. Y.**—Aug. 31, by Signal Supply Officer, Army Base, 58th St. and 1st Ave., 18,470 ft. cable and reels for same.

ELECTRIC CABLES and WIRES—**Akron, O.**—C. E. Wagner, 70 East Cuyahoga Falls Ave., interested in line of electric cables and wire for foreign representative in Carachas, Venezuela.

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CONCRETE—**Oklahoma City, Okla.**—Aug. 28, by M. Peshek, city clk., 700 cu.yd. concrete for Stiles Avenue Grade Crossing. $5,000. L. M. Bush, city engr.

ELECTRICAL SUPPLIES—**Harrisburg, Pa.**—Sept. 18, by J. L. Hanna, Dpt. Property & Supplies, electrical supplies to buildings of Commonwealth throughout state. $150,000.

†LUMBER—**Huntington, W. Va.**—Aug. 27, by U. S. Eng., lumber for Locks 14, 15, 16, 18, 19, 20, 22, 23 and 26, Ohio River, and Lock 3, Big Sandy River, and Lock 8, Kanawha River.

†PORTLAND CEMENT—**Huntington, W. Va.**—Aug. 28, by U. S. Eng., mill tested American portland cement in 4 or 5 ply paper bags for U. S. Locks 22 and 23 Ohio River.

## CONTRACTS AWARDED

CEMENT—**Burbank, Calif.**—City, 850 bbl. cement, to Blanchard Lumber Co., 5360 Lankershim Blvd., North Hollywood, $2,222.

PIPE, FITTINGS, etc.—**Gilroy, Calif.**—E. F. Rogers, city clk., pipe, fittings, materials for constructing transmission water line located within and without city limits, to U. S. Pipe & Fdry. Co., Monadnock Bldg., San Francisco, $29,632. Awarded Aug. 4. Noted July 26.

CRUSHED ROCK—**Los Angeles, Calif.**—City, A. J. Johnson, purch. agt., City Hall, furnishing Nos. 2, 3 and 4 crushed rock, during period ending Aug. 31, f.o.b. dealers bunker, Monrovia, to Blue Diamond Co., 1650 South Alameda St., Nos. 2 and 3, $1.20 per ton; No. 4 $1.35 per ton less 5% trade discount, total not to exceed $2,000. Awarded Aug. 8.

METAL HOSE, PIPE, etc. — **Los Angeles, Calif.**—City, Dpt. Water & Power, 207 South Bway., flexible metal hose, to Harmon Pacific Co., 422 East 3rd St., $2,621***pipe and fittings, Spec. 1470, to Pacific Southwest Pipe Co., 6800 Avalon St., $4,153***builders hardware, to Union Hardware & Metal Co., 411 East 1st St., $1,761***insulation board sheets, to Security Materials Co., 916 Formosa St., $7,260***miscellaneous pipe line couplings, Dresser type, to Grunnel Co. of Pacific, 520 Mateo St., $2,841***plumbing fixtures, to Crane Co., 321 East 3rd St., $5,914***black steel pipe, Spec. 1476, Item 1, to Pennsylvania Iron & Steel Co., 2308 Sante Fe Ave., $7,930***Item 2, to Ducommun Corp., 219 South Central St., $13,960***Item 3, to Hacker Pipe & Supply Co., 1725 East 7th St., $6,319***Item 4, to California Pipe & Supply Co. 2135 Atlantic St., $4,633. Grand total $57,392. Noted Aug. 2 and 9.

PIPE—**Los Angeles, Calif.**—Metropolitan Water Dist., 306 West 3rd St., furnishing 10,000 ft. 22-in. I D steel pipe, to Southern Pipe & Casing Co., Azusa, $7,644. Bids Aug. 10, awarded Aug. 13.

GATE VALVES—**San Francisco, Calif.**—City and San Francisco Co., three 30 in. and three 36 in. gate valves, to Iowa Valve Co., 501 Howard St., $4,693. **P.W.A.** Bids July 23, awarded Aug. 6.

REDWOOD TIES — **San Francisco, Calif.** — T. A. Brooks, city purch. agt., four thousand 6x8 in. x 8 ft. No. 1 California split Redwood tie for Hetch Hetchy Project, Bid 1242, to MacDonald & Harrington, 16 California St., San Francisco, $29,835 per M. F.B.M. Bids July 27, awarded Aug. 6.

CAST IRON PIPE — **Santa Monica, Calif.** — City Council, 10,000 ft. 6 in. and 2,500 ft. 4 in. c.i. pipe to meet A.W.W.A. requirements, to American Cast Iron Pipe Co., 412 West 6th St., Los Angeles, $7,913. Bids July 24, awarded Aug. 3.

TANK—**Danbury, Conn.**—Ford Coal & Oil Co., Inc., 30 East Franklin St., furnishing, erecting 100,000 gal. steel tank, to Pittsburgh & Des Moines Steel Co., 270 Bway., New York, $8,000.

TANK—**East Hartford, Conn.**—American Coal Co., Inc., 24 Central Row, Hartford, furnishing, erecting steel oil storage tank, to Chicago Bridge & Iron Wks., 250 Stuart St., Boston, Mass., $9,550. Awarded Aug. 8.

FILLING SAND—**Chicago, Ill.**—Dpt. P. Wks., City Hall, 12,000 tons filling sand by truck and 1,000 tons filling sand by rail, to Consumers Co., 111 West Washington St., $10,500. Bids Aug. 15, awarded Aug. 15.

HOSE—**Chicago, Ill.**—Dpt. P. Wks., City Hall, furnishing, delivering 10,000 ft. 50 ft. lengths, 3 in. doubled jacketed cotton rubber lined hose with couplings, to American-La France-Foamite Corp., 445 Lake Shore Dr., $10,300. Bids June 12, awarded Aug. 15.

MASON SAND—**Chicago, Ill.**—Dpt. P. Wks., City Hall, 2,600 tons mason sand by rail and 500 tons mason sand by truck, to Material Serv. Co., 33 North LaSalle St., $4,799. Bids July 2, awarded Aug. 15.

PIPE FITTINGS—**Chicago, Ill.**—Dpt. P. Wks., City Hall, furnishing, delivering and unloading c.i. pipe fittings, to Crane Co., 836 South Michigan Ave., $3,974. Awarded Aug. 15.

PORTLAND CEMENT—**Chicago, Ill.**—Dpt. P. Wks., City Hall, 30,100 bbl. portland cement by truck and 6,000 bbl. portland cement by rail, to Materials Service Co., 33 North LaSalle St., $102,750. Bids July 2, awarded Aug. 15.

CRUSHED AGGREGATE, etc. — **Indiana** — State Hy. Dpt., Indianapolis, 1,000 tons crushed aggregate, at Winslow, to Louisville Cement Co., Speeds, $1,610***750 tons gravel, at Carlisle, to Jackson & Squires, Newberry, $1,275*** 1,000 tons crushed aggregate, at Winslow, to Hy-Rock Products Co., Marengo, $1,610***750 tons gravel, at Elnora, to Meron Gravel Co., 208 Indianapolis Trust Bldg., Indianapolis, $1,275. Grand total $5,770. Bids July 31. Noted July 26.

GRAVEL—**Indiana**—State Hy. Comn., Indianapolis, 600 tons gravel at New Harmony, to Koch Sand & Gravel Co., Mount Vernon, $960 ***250 tons crushed aggregate at Delphi, to France Stone Co., Keeport, $350. Bids Aug. 8.

CRUSHED AGGREGATE — **Hobart, Ind.** — Lake Co., J. E. Finerty, aud., 7,000 tons crushed aggregate, to Moulding Brownell Co., 165 West Wacker Dr., Chicago, Ill., $9,753.

CRUSHED STONE — **Leipsic, Ind.** — Orange Co., D. K. McCart, aud., 1,248 cu.yd. crushed stone, to Bruebeck Bros., Orleans, $1,983.

TARMAC SLAG, etc.—**LeRoy, Ind.**—Lake Co., J. E. Finerty, aud., tarmac, to Koppers Products Co., Hammond, $7,633; 1,000 tons slag, to Illinois Slag & Ballast Co., Gary, $1,403.

ROAD OIL—**Rensselaer, Ind.**—Jasper Co., R. F. Allman, aud., road oil, to W. C. Babcock Grain Co., Rensselaer, $3,299.

ROAD OIL—**Willow Branch, Ind.**—Hancock Co., road oil, to Globe Creosoting Co., 1134 Circle Tower, Indianapolis, $8,323.

ROAD OIL—**Yorktown Ind.**—Delaware Co., W. M. Shafer, aud., Muncie, road oil, to J. P. Johnson & Co., 2100 South Harding St., Indianapolis, $19,599.

†BOAT SPIKES, etc.—**Duluth, Minn.**—U. S. Eng., Canal Park, boat spikes, nails and wire and machine bolts, nuts, washers, sleeve nuts, carriage bolts to Paper, Calmenson & Co., 975 East 7th St. St. Paul $46.93 and $94.77 respectively***round mill steel rods and flat bars and ice guard plates, anchor bolts and ice guard spikes, to J. T. Ryerson & Son, Inc., Post Office Box U, Chicago, Ill., $1,128 and $1,200 respectively. Grand total $2,470. Bids Aug. 1.

†PILING—**Duluth, Minn.**—U. S. Eng., Canal Park, furnishing, delivering 136 new round piling, 34 ft. long, to M. Messner, Houghton, Mich., at 14c. per ft., total $647.

†PORTLAND CEMENT — **Duluth, Minn.** — U. S. Eng., Canal Park, 7,100 sacks portland cement, for East Pier repairs, Ontonagon, Mich., to John Hawley, Ontonagon, Mich., $4,331. Bids Aug. 2.

†TWIST WIRES, etc. — **Vicksburg, Miss.** — U. S. Eng., 600,000 non-corrosive twist wires, to Crucible Steel Co. of America, 405 Lexington Ave., New York, N. Y., $14,640***60,000 squares non-corrosive wire fabric and 500,000 ft. non-corrosive, 3 wire strand, to Copperweld Steel Co., Glassport, Pa., $172,800 and $24,626 respectively. Grand total $212,066. Bids Aug. 1, awarded Aug. 7. Noted July 26.

†CABLE TERMINAL STRUCTURE—**Kansas City, Mo.**—U. S. Eng., furnishing portable cable terminal structure for Fort Peck Dredges, to Pacific Electric Mfg. Co., 5815 3rd St., San Francisco, Calif., $11,148.

BRONZE FITTINGS, etc.—**St. Louis, Mo.**—City, c/o B. L. Brown, pres. Bd. P. Wks., City Hall, brass fittings and valves for underground sprinkler system for Memorial Plaza, to Chase Brass & Copper Co., 312 North 2nd St., $6,577. Bids July 27.

PIPE—**St. Louis, Mo.**—Water Dpt., V. P. Roach, supt., 20,000 ft. 12 in. c.i. pipe, to Natl. Cast Iron Pipe Co., Land Bank Bldg., Kansas City, $1.171 per ft. (**Correction**—Contractor's name omitted.) Noted Aug. 9, under "Contracts Awarded."

TRUCKS—**Raleigh, N. C.**—Div. Purchase & Contr., A. S. Brower, dir., fifty 1½ ton trucks, 134 in. wheel base, to Chevrolet Motor Co., 522 West 11th St., Charlotte, $25,303.

†GENERATOR SET—**Memphis, Tenn.**—U. S. Eng., generator set for dredge, to General Electric Co., River Rd., Schenectady, N. Y., $2,860.

FIBRE BOARD, etc.—**Madison, Wis.**—Dpt. Agriculture, Forest Service Laboratory, fibre board and corrugator and poster, to S. Langston Co., 6th St. and Jefferson Ave., Camden, N. J., $27,500.

# FOREIGN

**Australia**—Dpt. P. Wks., Sydney, preparing plans 25 silo plants 60,000-90,000 bushels for which $1,000,000 had been voted***Australian Scientific Research Council, **Sydney,** plans 12

†*Federal Government.*

Foreign (Continued)

meteorological station around Antarctica, $1,250,000***Brisbane Ministry of Transport will expend $650,000 for 12 new railway locomotives and coaches.

**Azores, Ponta Delgada**—Nov. 5, by Clerk of Municipality, supplying hydro-electric plant, incl. 1 Francis turbine about 450 hp.; one 3 phase alternator; 1 oil cooled transformer, switchgear, etc.

**Dutch East Indies, Java**—Goodyear Tire & Rubber Co., Akron, O. and 600 West 58th St., New York, plans 300 tire daily capacity factory, at Buitenzorg. R. W. Hadley, c/o Export Dept., Akron, O., managing director for new plant.

**Egypt, Cairo**—Oct. 18, by Director General, Mechanical and Electrical Dpt., Ministry of P. Wks., supplying and erecting in Northern Nile delta, 3 complete electrical pumping stations, complete with buildings, machinery, etc. Plans, etc. can be obtained at Royal Egyptian Legation, Wash., D. C.

**England**—Electrical Comn., **Liverpool,** bids in September, constructing 4 boilers at Clarence Dock Power Station, $1,720,000***W. A. Forsuth, archt., London, preparing plans for Blackburn Cathedral addition in **Blackburn,** $1,000,000 available***Stockport** Town Council constructing 268 houses, to Thomas Davies & Sons, $378,525***Chesterfield** Town Council plans eelctrical plant addition, $322,500*** **Tipton** Urban Council, authorizes call for tenders soon, 666 houses, $865,800***Swan, Hunter & Wigham, Richardson, bids in fall aircraft manufacturing plant, **Wallsend on Tyne,** $500,000***Goodlass, Wall & Co., Liverpool, bids in fall, paint and varnish works, **Speke,** $400,000***Corporation of Liverpool bids in fall, airport, **Speke,** $330,000***Rover Motor Co. bids in fall, addition to plant in **Coventry,** $500,000.

**England**—Sept. 3, by Boro Electrical Engineer, 85 London Rd., **Southend-on-Sea,** 2 years' supply high tension and low tension underground cables***Sept. 7, by A. G. Newman, ch. city engr., **Bristol,** supplying, erecting and putting into service 4 steam raising units, each 130,000 lbs. per hr. capacity, normal economic rating, complete with superheaters, economizers, stokers and auxiliary plant.

**Ethiopia, Addis Ababa** — Compagnie du Chemin de Fer Franco, Ethopien, Paris, France, plans improving line between Addis Ababa and port of Jibuti in French Samaliland; Government plans road programme, incl. road from Addis Ababa to Gambeila. Machinery and other equipment required.

**India, Calcutta**—Banergee & Co., 118 Raja Dinendra St., in the market for supply creosoted douglas fir timber, 25% ad valorem customs duty. Cable "Dhalga" Calcutta.

**Japan, Hiroshima**—Showa Artificial Silk Co. Ltd., Ajinomato Bldg., Kyobashi, Tokyo, bids about Sept. 1, constructing and equipping rayon plant, power plant, etc., here. To exceed 2,500,000 yen.

**New Zealand**—Sept. 12, by **Dunedin** City Engineer, supplying three 150 kva. and three 1,000 kva. 3 phase, oil cooled outdoor type transformers and voltage regulator for use on 6,600 volt, 3 phase circuit***Sept. 11, by Director Ports & Telegraph Dpt., **Wellington,** supplying 40 mi. insulated and braided bronze wire in 440 yd. lengths; Sept. 12, 40 mi. flameproof gumper wire, 100 mi. 1/.044 and 30 mi. 1/.036 V.I.R. twisted pair tinned copper wire; Sept. 13, year's supply paper insulated lead covered and armored telegraph cables.

**Panama, Puerto Armuelles**—Government preparing plans constructing concrete wharf, $300,000.

**Peru, Lima**—E. Christin, Casilla 828, in market for supply of rectifier or transformer for 220 volt, 60 cycle a/c current and to transform so that it will give 25 amperes for 25 positive plates in charring tank. Duty s/o .05 per gross kilo. Fitzgerald Mfg. Co., Torrington, Conn., reference.

**Scotland, Falkirk**—Falkirk Water Bd. preparing plans constructing dam on River Carron, $1,250,000.

**Spain, Madrid**—Norte Railway Co. bids in fall, supplying 40 locomotives, 16,000,000 pesetas; Madrid-Zaragoza-Alicante Railway Co., supplying 60 locomotives, 24,000,000 pesetas.

**Union Soviet Socialist Republics** — Soviet Government, Moscow, or c/o Amtorg Trading Corp., 261 5th Ave., New York, tea factory, 1,100,000 lb. per season capacity, in Ozurget Dist, Georgia, by day labor. $500,000 or more.

**†Union Soviet Socialist Republics**—Soviet Government, Moscow, or c/o Amtorg Trading Corp., 261 5th Ave., New York, hospital, sanitarium and laboratory, at Borzhom, by day labor, $500,000.

**Union Soviet Socialist Republics** — Commissariat of Electric Power, Soviet Govt., **Moscow,** or c/o Amtorg Trading Corp., 261 5th Ave., New York, preliminary work now starting hydro-electric plant, incl. large saw mill, settlement for 10,000 workmen, at Levshino, vicinity or Perm, by day labor, $15,000,000.

**Union Soviet Socialist Republics** — Commissariat Rail Transportation, Moscow, or c/o Amtorg Trading Co., 261 5th Ave., New York, bridges, railway stations, terminals, locomotive roundhouses, machine repair shops, along route of Stalinsk-Mundibash Railway, by day labor, to exceed $5,000,000; Commissariat of Heavy Industry, Moscow, or c/o Soviet Government, c/o Amtorg Trading Corp., 261 5th Ave., New York, purchasing in United States $15,000,000 worth of steel mill machinery, incl. rolling and strip mills. United Eng. & Fdry. Co., Pittsburgh, Pa. is bidding on the job.

**Wales, Cardiff** — Guest, Keen & Nettlefolds Ltd., bids in September, constructing steel works for manufacturing steel rods and bars, $750,000.

## PUBLIC BUILDINGS

### PROPOSED WORK

**Ala., Troy**—City making plans installing Butane-air gas plant and 68,000 ft. 2- to 4-in. cl. mains, P.W.A. project. Charles A. McKeand & Associates, Troy, engrs.

**Ark., Newport**—Indefinitely postponed action on proposed municipal light and power plant and distribution system. $178,000. Project practically abandoned. Noted June 8.

**Calif., Fresno**—City plans by an Association of architects, incl. W. D. Coates, Jr., C. H. Fenklin, E. J. Kump, Fred Swartz, H. R. Lake and E. W. Peterson, Fresno, new civic auditorium, $375,000. P.W.A. appropriated $120,000. Noted July 19.

**Calif., Los Angeles**—Bd. Educ. plans by E. Weston, Jr., 807 Architects Bldg., reconstructing, rehabilitating and strengthening George Washington High School, incl. administration building, science, cafeteria, shop and art buildings and connecting arcades, $254,908. O. G. Bowen, 1144 South Grand St., struct. engr.

**Calif., Los Angeles**—Bd. Educ., commissioned C. M. Winslow, Architects Bldg., to prepare plans for new 30 unit building replacement of Miramonte School, 1400 East 68th St. Est. $195,000.

**Calif., Oakland**—Supervs. Alameda Co., plans by W. E. Schirmer, J. W. Plachek, C. Werner, W. J. Corlett and H. A. Minton, 910 Bank of America Bldg., courthouse. G. M. Simonson, 20 Loreta Ave., Piedmont, engr. Noted May 17.

**Calif., Oakland**—City School Dist. plans reconstructing school buildings for earthquake proofing, $500,000.

**Calif., Sacramento**—Sacramento Calif. Valley and Dist. making plans power plant and electric distribution system, $20,000,000. Burns & McDonnell Eng. Co., 107 West Linwood Blvd., Kansas City, Mo., engrs.

**Calif., San Bernardino** — San Bernardino Valley Junior College Dist., election Nov. 6, $268,000 for constructing auditorium, $225,000; technical building $60,000; women's gymnasium $65,000. P.W.A. approved $105,000 grant and $245,000 loan. Noted June 28.

**Calif., San Francisco**—City and San Francisco Co., plans by W. D. Mooser, Monadnock Bldg., E. A. Eames, 353 Sacramento St. and D. Stone, 110 Sutter St., class "A" Francis Scott Key School. Est. $115,000 or more.

**Calif., San Francisco**—City and San Francisco Co., plans by W. D. Peugh, 333 Montgomery St. and G. A. Dailey, 210 Post St., Class "A" school known as "Patrick Henry School." Est. $115,000 or more. To be financed by bond issue of 1933, incl. PWA funds.

**†Calif., San Francisco**—Con. Q. M., Fort Mason, made plans and soon takes bids repairing boilers, furnaces, pumps, burners and refrigerating equipment at Letterman General Hospital Power Plant, San Francisco Presidio.

**Calif., Sebastopol**—Analy Union High School Dist. plans by L. C. Stone & J. R. Rowell, Humboldt Bank Bldg., San Francisco, 2 story rein.-con. high school, $175,000 or more. N. Green, 55 New Montgomery St., San Francisco, structural engr. R. L. St. John, 544 Market St., San Francisco, mechanical engr. Noted July 5.

**Conn., Weston** — School Bd., Weston, plans new high school for towns of Weston, Ridgefield, Wilton, Cannondale, Georgetown, Easton and Redding. $105,000. **Maturity indefinite.** Architect not appointed.

**D. C., Wash.**—District Comrs., District Bldg., rejected bids July 31, constructing **Anacostia** Junior High School. Noted July 19.

**Ill., Sycamore**—School Bd., J. W. Patten, pres., sketches by F. E. Dougherty, 79 West Monroe St., 2 story, basement, 100x140 ft., school $125,000. P.W.A. funds allotted. Noted Apr. 5.

**†Ind., Attica**—Treas. Dpt. at office Sup. Archt., Wash., D. C., making plans U. S. Post Office, Mill and Main Sts., $50,000. Site purchased.

**Ia., Decorah** — Bd. Educ. election Sept. 14, $100,000, rein.-con. brick, stone school, $125,100 allotted by P.W.A. Noted Aug. 2.

**Ia., Oskaloosa**—City, G. E. Burdock, mayor, postponed indefinitely construction power and light plant and distribution system, $462,000. May revive project in 1935. Noted Jan. 25.

**Kan., Manhattan**—Kansas State College, plans chemistry and science building. To exceed $150,000. Architect not appointed.

**†Md., College Park**—Bureau Mines plans chemical and metallurgical laboratories at experiment station at University of Maryland.

**Miss., Jackson**—City plans power plant. Burns & McDonnell Eng. Co., 107 West Linwood Blvd., Kansas City, Mo., engrs.

**Mo., Kirksville**—Kirksville Bd. Educ. plans by Bonsack & Pearce, Inc., 411 Olive St., St. Louis, two 2 story, basement, brick schools, $225,000 bonds voted. Noted Nov. 2, 1933.

**Mo., St. Louis**—Bd. P. Serv., City Hall, soon takes bids dormitory for dairy employees, hospital building and additional 12 in. watermain at St. Louis Training School for Feeble Minded on Bellefontaine and Lorimer Rds. in St. Louis Co.; an additional ward building, altering electric generating plant, new power lines at Robert Koch Hospital, Koch; additional kitchen building at City Sanitarium, $125,000. P.W.A. project. A. Osburg, city archt. W. C. E. Becker, city engr.

**N. Y., Baldwin**—Municipality plans by T. W. Craddock, 69 Miriam St., Valley Stream, fire station. Est. about $105,000. $50,000 allotted by P.W.A.

**N. Y., Churchville**—Municipality plans by C. C. Ade, 80 East Ave., Rochester, school, $150,000. Noted Mar. 22.

**N. Y., Corinth**—Bd. Educ. soon takes bids, brick, steel grade and high school, plain found, $250,000. J. R. White, 109 State St., Albany, archt. Noted Apr. 5.

**N. Y., Lockport**—City, H. F. Thurston, mayor, election in November, on bonds for municipal hydro electric plant, $908,000. P.W.A. project. L. A. Harding, Prudence Bldg., Buffalo, engr.

**N. Y., Long Beach**—Union Free School Dist. 28, plans by W. S. Schneider, 101 Park Ave., New York, high school, Lindell Blvd. and Hudson St. $1,200,000. P.W.A. project. Noted Apr. 5.

**N. Y., New York**—Dpt. Markets, Municipal Bldg., rejected bids July 27, 48 wholesale stores at Bronx Terminal Market; rejected bids Aug. 6 for heating and ventilating; rejected bids Aug. 8, for extending refrigeration system, and rejected bids July 31, for plumbing and drainage work. Revised plans in progress, and new bids due about Sept. 15. Noted July 19 and 26 and Aug. 2.

**N. Y., Rockville Center**—Dpt. P. Utilities, plans power plant addition $260,000. P.W.A. funds allotted. H. C. Major, engr. Noted Feb. 1.

**N. Y., Rome**—City plans 3 story, basement, hospital. Garden St. Est. about $105,000. City to apply for F.E.R.A. grant from Government. Architect not appointed. **P.W.A.**

**N. Y., Truxton**—Village School Bd. plans completed by C. W. Clark, State Theatre Bldg., Cortland, and takes bids probably 1st week in September, 2 story, basement, central high school, plain found. $125,000. Noted July 19.

**Pa., Emaus** — Boro, Boro Hall, plans constructing power plant and transmission line, $265,000. Will authorize bond issue after approval by Boro.

**R. I., Lincoln**—J. Smith, supt. school, Town Hall, plans by A. R. Humes, Record Bldg., Pawtucket, brick and steel school. $200,000 appropriation approved.

**Tenn., Tellico Plains**—City, plans by Barber & McMurray, General Bldg., Knoxville, school. Est. $125,000. Noted July 12.

**Tex., Dallas**—City and Dallas County, plans by Green, La Roche & Dahl, Insurance Bldg., improvements to Parkland Hospital. Est. $340,464. Plans bond election. Noted Aug. 9.

**†Tex., Marshall**—U. S. Government Subsistence Homesteads, Marshall, sketches fifty 4 to 5 story subsistence homesteads, incl. electric refrigeration. $140,000.

**Tex., San Antonio**—City, C. K. Quin, mayor, submitted new application to P.W.A. for loan for constructing fireproof armory. $250,000. R. H. Cameron, Majestic Bldg., archt.

**Tex., Seguin**—Guadalupe Co., c/o H. A. Heidcke, judge, voted $200,000 for courthouse and jail. Noted July 19.

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*†Federal Government.*

Public Buildings (Continued)

**Que., Quebec City**—Provincial Dpt. of P. Wks. bids this fall, annex to Parliament buildings, St. Augustine St., $300,000.

**BIDS ASKED**

**†Calif., San Fernando**—Sept. 14, by Treas. Dpt. at office Sup. Archt., Wash., D. C., U. S. Post Office.

**†D. C., Wash.**—Sept. 11, by Treas. Dpt. at office Sup. Archt., Wash., D. C., miscellaneous building changes and constant temperature rooms in extensible building, scientific laboratory, Dpt. Agriculture.

**†Ill., Eureka**—Aug. 27, by Twenty-First Forestry Dist., R. M. Madison, commander, Jefferson Barracks, Mo., kitchen and mess building, bathhouse, 2 latrines, headquarters, 6 barracks buildings, first-aid building, pump and power building, garage, forestry office and quarters, warehouse.

**Ill., Highland**—Sept. 4, by Bd. Educ., C. F. Rawson, secy., Highland School, constructing school. $194,000. P.W.A. project. Knoebel & Pabst, Highland, archts. Noted Mar. 8.

**Ill., Moline**—Sept. 6, by Bd. Educ., C. R. Rosborough, pres. School Bd., constructing school. $129,000. P.W.A. project. W. H. Schulzke, 5th Avenue Bldg., archts. Noted Jan. 11.

**†Ind., Decatur**—Decatur Homesteads, A. A. Watrous, mgr., taking bids houses, $225,000. McNally & Quinn, 10 South LaSalle St., Chicago, Ill., engrs.

**†Ia., Sheldon**—Aug. 29, by Treas. Dpt. at office Sup. Archt., Wash., D. C., U. S. Post Office.

**Md., Baltimore**—State, M. A. Rackord, genl., c/o National Guard, taking bids heating and plumbing systems for 5th Regiment Armory. H. Adams, Inc., Calvert Bldg., engrs.

**Mo., St. Louis**—Sept. 5, by Bd. Educ., 911 Locust St., general contract 2 story, basement, brick, steel, stone addition to Columbus School, 3120 St. Louis Ave., $95,000; 2 story, basement addition to Gundlach School, 2931 Arlington Ave., $60,000. P.W.A. project. E. T. Friton, 911 Locust St., engr. and archt.

**†N. H., Lancaster**—Sept. 4, by Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing U. S. Post Office. Noted Feb. 8.

**N. J., Trenton**—Aug. 28, at office W. J. Ellis, comr. Dpt. Institutions & Agencies, State Office Bldg., Trenton, constructing recreation building at State Home for Girls. P.W.A. project.

**N. Y., Bedford Hills**—Sept. 6, by Commissioner Correction, State Office Bldg., Albany, construction, heating, sanitary work, electrical work and electric fixtures, for administration building and service connections, Westfield Farms, Bedford Hills.

**†N. Y., Buffalo**—Aug. 29, by Treas. Dpt. at office up. Archt., Wash., D. C., constructing garage and tool house.

**N. Y., Coxsackie**—Aug. 30, by Dpt. Correction, State Office Bldg., Albany, construction, heating, sanitary work, electrical work, for gymnasium, shop building and addition to existing buildings, at New York State Vocational School.

**N. Y., Coxsackie**—Sept. 5, by Dpt. Correction, State Office Bldg., Albany, heating work, sanitary work, equipment and bakery equipment ovens, etc. at Division D, New York State Vocational Institution.

**N. Y., DeRuyter**—Bd. Educ. bids about Sept. 1, Junior and Senior High School, 2 story, basement, brick, steel, plain found., $145,000. C. W. Clark, Cortland, archt. Noted July 19.

**N. Y., Elmira**—City, City Hall, taking bids for materials for county garage. Work by day labor. $35,000. F.E.R.A. funds.

**N. Y., Elmira**—Sept. 20, by Commissioner Correction, State Office Bldg., Albany, constructing, heating, sanitary, electrical work, and coal handling apparatus for power house and service connections, at Elmira Reformatory.

**N. Y., Ithaca**—Sept. 6, by Dpt. Health, State Office Bldg., Albany, completing sanitary work at Herman M. Biggs Memorial Hospital.

**N. Y., Kings Park**—Aug. 29, by Commissioner Dpt. Mental Hygiene, State Office Bldg., Albany, constructing refrigeration work, standard electric fixtures, bakery, storehouse and refrigeration plant. Building 44, Kings Park State Hospital. Noted Aug. 16.

**N. Y., Oneonta**—Aug. 30, by Commissioner Dpt. Health, State Office Bldg., Albany, constructing sanitary work at hospital for treatment of tuberculosis.

**N. Y., Pine Aire Station**—Sept. 5, by Commissioner Dpt. Mental Hygiene, State Office Bldg., Albany, constructing miscellaneous additional work at Buildings 21 to 24 (inclusive), Pilgrim State Hospital.

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**N. C., Wentworth**—Aug. 28, by Bd. Educ. Rockingham Co., J. E. McLean, secy., additions to Leaksville, Burton Grove, Lakeside, North Spray and Draper Schools. Leaksville Twp.; 1 school in Williamsburg Twp. and 1 school in Huntsville Twp., incl. well house and sewerage disposal plant, J. W. Hopper, Leaksville, archt.; 2 new buildings and 1 addition to schools in Reidsville, known as North End School, South End School and addition to high school for colored people, J. B. Heard, Danville, archt.; remodeling 2 schools in Madison, known as West and East Elementary Schools, H. Barton, Greensboro, archt. To exceed $300,000. Heating and plumbing under separate contracts.

**†Ore., Corvallis**—Sept. 6, by Treas. Dpt. at office Sup. Archt., Wash., D. C., miscellaneous changes in U. S. Post Office.

**†Tex., Fort Sam Houston**—See "Contracts Awarded."

**Wash., Pullman** — Sept. 4, by Bd. Regents, Washington State College, Pullman, 1 story, 60x100 ft., power house and equipment, campus. $260,000. Stanley & Smith, Pullman, engrs. Noted Mar. 29.

**CONTRACTS AWARDED**

**Calif., Los Angeles**—Los Angeles Co., Hall of Records, three 1 story, rein.-con. infirmary units and arcades, Blocks "C," "D," "E," incl. steam heating, water and sewage connections and electrical extensions at Rancho Los Amigos, to Person & Thiele, 6206 San Vicente Blvd., $156,700. Est. $133,000. P.W.A. project. Noted Aug. 9.

**†Calif., San Diego**—Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing Senior Medical Officers Quarters at Quarantine Station, to Olmstead Building Co., 1847 Hancock St., $15,495. Bids July 31. Noted July 19.

**†D. C., Wash.**—Architect of Capitol, 9 new elevators and altering existing elevators in Capitol Building, to Otis Elevator Co., 810 18th St., $150,642. Bids July 27. Noted July 31 Daily.

**D. C., Wash.**—District Comrs., District Bldg., heating system in Ketchum, Payne and Randall Heights Schools, to R. E. Anderson, 809 Maryland Ave. N.E., $16,999.

**†Ind., South Bend**—Treas. Dpt. at office Sup. Archt., Wash., D. C., U. S. Post Office, at Notre Dame Campus, to T. C. Hickey, South Bend, Maginnis & Walsh, Statler Bldg., Boston, Mass., archts.

**†Ind., Sullivan** — Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing U. S. Post Office, to A. C. Atherton, 1024 Judson Ave., Evansville, $36,643. Bids Aug. 2. Noted July 19.

**†Mich., Hancock**—Treas. Dpt. at office Sup. Archt., Wash., D. C., U. S. Post Office, to Fleisher & Son, 444 Loeb Arcade, Minneapolis, Minn., $41,113. Bids July 25. Noted July 19.

**Minn., Winona**—Bd. Educ., plumbing for 2 story, 157x246 ft. school, to Mechanical Constr. Co., Hibbing, $12,990***heating, to Reuben L. Anderson, Inc., 1834 St. Clair St., St. Paul, $26,841. Noted July 26 under "Contracts Awarded."

**Miss., Whitfield** — State Hospital, furnishing plumbing and heating facilities to 6 doctors' residences at State Insane Hospital, to J. P. Williams, Jackson, $4,500; electrical facilities, to Short Electric Co., Jackson, $1,376. Bids July 30, awarded Aug. 7.

**Mont., Bozeman**—State Bd. Educ., E. Ireland, secy., Helena, plumbing and heating for student resident hall, to Northern Plumbing & Heating Co., Billings, $39,975. **P.W.A.** Noted July 26, under "Contracts Awarded."

**Mont., Butte**—State Bd. Educ., Helena, general contract part 2 and 3 story, brick, tile residence hall at Montana School of Mines, to Lovering-Lonsbotham Co., 606 Builders Exch. Bldg., St. Paul, Minn., and to Paul Steenburg Constr. Co., W1757 1st Natl. Bank Bldg., St. Paul, Minn., $201,869. **P.W.A.** Bids Aug. 9.

**†Neb., Wayne**—Treas. Dpt., at office Sup. Archt., Wash., D. C., constructing U. S. Post Office, to P. Sothman, Grand Island, $38,525. Bids Aug. 1. Noted July 19.

**N. J., Skillman** — Institutions & Agencies, State Office Bldg., Trenton, 400 hp. boiler, etc., for Epileptic Village, to E. Keeler Co., Williamsport, Pa., $9,136. Bids July 26, awarded Aug. 13. Noted July 19.

**†N. Y., Binghamton**—Coath & Goss, Inc., general contractors, 228 North LaSalle St., Chicago, 640 tons structural steel for post office, to Lehigh Structural Steel Co., Allentown, Pa., for Treas. Dpt., at office Sup. Archt., Wash., D. C. Noted July 19, under "Contracts Awarded."

**N. Y., Chestertown**—School Bd., heating and ventilating, to Haneline Co., Inc., 529 Oriskany St. W., Utica, $20,769***plumbing, to Cohn & Kramer, Inc., 48 Grand St., Albany, $7,831 ***electrical work, to Doster & Egan, 204 Erie Blvd. E., Syracuse, $5,997. Grand total $34,597. **P.W.A.** Bids June 1. Noted May 31, under "Contracts Awarded."

**N. Y., Cold Springs**—Bd. Educ., Putnam Valley School Dist. 1, general contract school, to C. P. Boland, 101 Park Ave., New York, to exceed $100,000. **P.W.A.**

**N. Y., Elmira**—See "Bids Asked."

**N. Y., Jamaica** — Dpt. Hospitals, Municipal Bldg., general contract constructing Queens General Hospital, to W. Kennedy & Co., Inc., 215 Montague St., Brooklyn, $108,423*** heating, to Afgo Eng. Co., 142 Fulton St., New York, $17,683***plumbing, to Worster & Hamilton, 2521 23rd St., Astoria, $34,07 ***electrical work, to Jandous Electric Equipment Corp., 210 East 40th St., New York, $23 700. Grand total $184,343. Noted May 31.

**†N. Y., Malone**—M. E. Ryan Co., general contractors, 1545 Union St., Schenectady, 200 tons structural steel, for U. S. Post Office, to Shippers Car Line, Inc., Milton, Pa., for Treas. Dpt. at office Sup. Archt., Wash., D. C. Noted Aug. 9, under "Contracts Awarded."

**N. Y., New York** — National Surety Co., 4 Albany St., New York, will do plumbing work at Rikers Island Penitentiary, work by separate contracts, for A. H. McCormick, comr. Dpt. Correction, Municipal Bldg. Bids June 15 rejected. Noted May 31.

**N. Y., Saratoga Springs**—J. J. Turner & Sons, general contractors, 120 Guy Park Ave., Amsterdam, 400 tons structural steel for sanitarium, to Smith & Caffrey Co., 2611 Lodi St., Syracuse, for Saratoga Springs Authority. Noted Aug. 2 under "Contracts Awarded."

**Okla., Chickasha**—Grady Co., 4 story, basement, 70x120 ft., rein.-con., brick court house, plain found., to D. A. Harmon, Elks Bldg., Oklahoma City, $166,826. **P.W.A.**

**†Tex., Fort Sam Houston**—Con. Q. M., semi-fireproof theatre building, own forces, $90,000. Noted Aug. 2.

**†Wis., Milwaukee**—U. S. Eng., Milwaukee, general contract Gray's Reef Light Station, to Greiling Bros., Green Bay, $108,588; control for diesel engine, to Fairbanks Moore Co., 900 South Wabash Ave., Chicago, Ill., $10,734. Awarded Aug. 13.

## COMMERCIAL BUILDINGS

**PROPOSED WORK**

**Calif., San Francisco**—Recorder Printing & Publishing Co., 460 4th St., plans by W. P. Day, Financial Center Bldg., 3 story, rein.-con. printing and publishing plant, 12th St. and Van Ness Ave. S. To exceed $100,000.

**Conn., Bridgeport**—H. C. Elton, archt., 1188 Main St., soon let contract 1 story 100x200 ft. rein.-con., brick store, Fairfield Ave., for Yale University, W. M. Hotchkiss, 205 Church St., New Haven. $105,000.

**Conn., Meriden**—Meriden Hospital, 181 Cook Ave., M. E. McIntyre, supt., plans brick, steel hospital unit, incl. pathological and X-ray departments, Cook Ave. $300,000. Engineer and architect not appointed.

**Mo., St. Louis**—Washington University, c/o G. R. Troop, chancellor, Lindell and Skinker Blvds., sketches by W. D. Crowell, c/o Mauren, Russell & Crowell, 1620 Chemical Bldg., rein.-con., brick, stone social service building. Site not selected.

**N. J., Newark**—Anshe Russian Congregation, J. Konvitz, rabbi, plans by Liebowitz & Matzner, 211 Front St., Plainfield, synagogue. $125,000.

**N. Y., Brooklyn**—Gel Steia Corp., 1555 55th St., plans by M. W. Weinstein, 93 Court St., 6 story, apartment, 100 Avenue P. $140,000.

**N. Y., Brooklyn**—Inos Realty Corp., 253 Montgomery St., New York, plans by N. E. Ungerleider, 101 Joralemon St., 6 story apartment, 2302 Avenue O. $150,000.

**N. Y., Brooklyn** — Kings Highway Theatre Corp., R.K.O. Theatres, lessee, 1270 — 6th Ave., New York, bids late in fall, theatre, Kings Highway and Ocean Ave., c/o T. W. Lamb, archt., 701 7th Ave., New York. $250,000. Noted July 26.

**N. Y., Jamaica**—Jamaica Fulton Operating Co., 6th Ave. and 50th St., bids late in November, theatre. $250,000. T. W. Lamb, 701 7th Ave., New York, engrs. R.K.O. Theatre Corp. 1270 6th Ave., New York, lessee. Noted Aug. 2.

**N. Y., New York**—Public National Bank & Trust Co., 76 William St., plans by Schwartz & Gross, 347 5th Ave., New York, 3 story bank, 102 Orchard St. $200,000.

**N. Y., New York**—Riverside Drive Corp., c/o Isadore B. Geller, 122 East 42nd St., plans heating, plumbing, alterations in 6 story, 100x100 ft. apartment, 557 West 124th St. Est. about $30,000.

**Pa., Elizabethtown**—Masonic Home Building Com., Masonic Temple, Phila., soon lets contract 3 story, basement, 50x150 ft. brick, steel building known as Kuhlemeier Cottage, plain found., on Masonic Grounds, $135,000. Zantzinger, Borie & Medary, Architects Bldg., Phila., archts.

*†Federal Government.*

Commercial Buildings (Continued)

**BIDS ASKED**

**La., New Orleans**—Sept. 19, by L. S. Weil and W. B. Moses, archts., 427 South Peters St., installing plumbing facilities, switchboards, cooling tower, and refrigerating equipment for 700 ton air conditioning system for 14 story office building, for Whitney Natl. Bank, St. Charles and Gravier Sts. $250,000.

**N. Y., Bayside**—See "Contracts Awarded."

**N. Y., Queens Village**—See "Contracts Awarded."

**CONTRACTS AWARDED**

**Md., Baltimore**—May Dpt. Stores, air conditioning equipment for department store, to York Ice Mchy. Co., York, Pa. Est. $40,000 or more.

**Mo., Kirkwood**—Carmelite Sisters of Divine Heart of Jesus, St. Charles, general contract 3 story, basement, rein.-con., brick, stone home for aged convent, Manchester Rd. and Woodlawn Ave., to Selden-Breck Constr. Co., Fullerton Bldg., St. Louis. Est. $150,000. Noted Dec. 5.

**Mont., Glasgow**—Frances Mahon Deaconess Hospital, R. M. Young, chn., Bd. Directors, general contract 3 story, basement, 41x156 ft. hospital addition, rein.-con., brick, tile curtain walls, to McGough Bros., 1954 University Ave., St. Paul Minn., $82,600. Bids Aug. 2. **P.W.A.** Noted Aug. 2.

**N. Y., New York**—Citizens Savings Bank, 54 Bowery, altering plumbing, heating in 6 story apartment, 82 West 12th St., separate contracts awarded. $30,000. Sugarman & Berger, 17 East 49th St., archts.

**N. Y., New York**—Rockefeller Center Corp., Rockefeller Plaza, escalators in offices and stores, 5th Ave. and 50th St., to Otis Elevator Co., 11th Ave. and 26th St., $125,000.

**N. Y., Queens Village**—Fellows & Fries, 208th and Hillside Aves., group of 24 dwellings, 208th and Hillside Aves., day labor and separate contracts. $100,000 or more.

**Pa., Harmarville**—H. H. Henderson, ch. engr. Gulf Refining Co., Gulf Bldg., Pittsburgh, general contract one 1 story and two 3 story concrete research laboratory buildings, to W. T. Grange Constr. Co., Kennan Bldg., Pittsburgh*** electrical work, to Lord Electric Co., Plaza Bldg., Pittsburgh***plumbing and heating, to Campbell, Huggins & Donat, 119 Meyran Ave., Pittsburgh. Est. $200,000. Noted Aug. 9.

**Wis., Madison** — Blessed Sacrament Church, c/o Rev. Bartholemy, general contract 1 story, basement, 60x100 ft., brick, steel, church, to R. F. Conlon, Dubuque, Ia. Awarded Aug. 11. Noted July 12.

## INDUSTRIAL BUILDINGS

**PROPOSED WORK**

**Conn., Meriden**—PLANT—Lyon & Billard Co., Hanover St., making plans to rebuild lumber plant damaged in $200,000 fire, Hanover St. To exceed $30,000. Private plans.

**Ind., Gary**—MILL—Illinois Steel Co., Gary, Ind., subsidiary of U. S. Steel Co., 71 Bway., New York, plans new rolling unit. $2,500,000. Private plans.

**Ia., Riverside**—STORAGE, etc.—R. H. Heitzman Hardware Co., plans altering and repairing storage distribution and store. To exceed $35,000. Architect not appointed.

**Me., Millinocket** — POWER PLANT — Great Northern Paper Co. plans power plant, $80,000. H. J. Deutchbein Co., 350 Fifth Ave., New York, engrs.

**Mich., Detroit**—FACTORY—American Brakeblok Corp., Merritt Ave., plans 2 story, brick, steel, concrete factory and office, plain found., Merritt St. Est. about $50,000. Private plans.

**Mich., Elsie**—REFINERY—Maxwell & Ray Lewis, Ovid, plan immediate erection 1,000 or 1,500 bbl. petroleum refinery. $60,000 or more. E. G. Guy, c/o owner, engr. Noted June 21.

**Mich., Muskegon** — OIL REFINERY — Old Dutch Refining Co., Inc. plans 1,000 bbl. oil refinery in New Home Twp., Montcalm Co. Engineer and architect not appointed. To exceed $50,000.

**Mich., Saginaw** — STORAGE and WAREHOUSE—Morley Bros. Hardware Co., 115 North Washington St., plans storage and warehouse. To exceed $100,000. Engineer and architect not appointed.

**Minn., Minneapolis**—GRAIN ELEVATOR—Stratton Grain Co., W. K. Kellogg, branch mgr., 369 New Chamber of Commerce Bldg., plans completed by L. H. Abbey, Flour Exch., grain elevator addition, 12th Ave. S. E. and Great Northern Ry. tracks. $60,000.

**Minn., St. Cloud** — WAREHOUSE, etc. — International Harvester Co., L. H. Hinz, branch mgr., East St. Germain St., plans brick, concrete, motor truck warehouse and service garage, East St. Germain St. and Great Northern Ry. tracks. $40,000.

**Mo., Albany**—SHOP and GARAGE—J. L. Enyart, Albany, plans 1 story brick shop and garage. $30,000 or more. Architect not appointed.

**Mo., Bath**—SHIPBUILDING—See "Unclassified."

**N. Y., Buffalo**—CREAMERY and STORAGE—P. J. Cleary (rep. owner), 195 Scott St., plans brick, concrete cold storage and creamery, Scott St. $70,000.

**N. Y., New York**—DISTRIBUTION PLANT—Jaburg Bros., 84 Hudson St., plans distribution plant, 84 Hudson St. $30,000 or more.

**N. Y., Lyndonville**—PLANT—Speas Mfg. Co., 2600 Front St., Kansas City, Mo., plans plant, $80,000.

**N. Y., New York**—WAREHOUSE and DISTRIBUTION—Corporation, c/o H. McLean Purdy Management, 381 4th Ave., plans 12 story warehouse and distribution, 40th St. and 11th Ave. To exceed $300,000.

**N. Y., New York**—STORAGE—Railway Express Agency, 219 East 42nd St., plans by H. O. Weigand, c/o owner, altering storage and office building, 219 East 42nd St. $150,000.

**N. Y., Ovid**—ELECTRIC PLANT, etc.—New York State Electric & Gas Corp., Ithaca, plans electric plant and power lines here and in Seneca Co. $25,000 or more.

**N. Y., Sherburne**—POWER PLANT—Utica Knitting Co. plans power plant addition. Private plans.

**O., Cincinnati**—GRAIN ELEVATOR—Early & Daniels Co., c/o R. Early, making plans grain elevator 10,000 bu. per day capacity and several smaller ones with 2,000 bu. per day capacity, Beckman St. $100,000. Horner & Wyatt, Kansas City, Mo., engrs.

**O., Cincinnati**—MEAT PACKING PLANT—Tietig & Lee, archts., 34 West 6th St., soon lets contract 2 story, basement meat processing plant, brick, concrete, Summer St., for Kroger Grocery & Baking Co., 35 East 7th St. Est. $500,000. A. M. Kinney, Inc., Caren Tower, engr. Noted July 19.

**O., Cleveland**—BREWERY—Tivoli Brewing Co., M. G. Coulter, mgr., 3576 Carnegie Ave., plans brick, steel, concrete brewery $200,000. Engineer and architect not appointed.

**Pa., Indiana** — SUB-STATION — Associated Gas & Electric Co., 61 Bway., New York, plans electric power sub-station (Possum Glory Sub-Station). $100,000.

**Tex., Shamrock**—YARDS and STORAGE—J. C. Woodridge Lumber Co. plans constructing yards and storage. $30,000 or more. Architect not appointed.

**Va., Charlottesville**—BRANDY DISTILLERY—Corporation, c/o S. Hamm, Charlottesville, plans 500 gal. daily capacity brandy distillery. To exceed $100,000.

**B. C., Kelowna** — PLANT — Kelowna Cold Storage Ltd. making plans cold storage building, $50,000.

**Ont., Agincourt** — PLANT — R. J. Kirkland, Dalkeith, plans constructing plant for production of chemicals, $50,000.

**BIDS ASKED**

**California** — ORE MILL — See Contracts Awarded."

**Ky., Lexington**—DISTILLERY—Schenley Distillers, 20 West 40th St., taking bids constructing distillery. To exceed $150,000. C. J. Kiefer, Schmidt Bldg., Cincinnati, O., engr. and archt.

**Minn., Minneapolis**—GRAIN ELEVATOR—See "Contracts Awarded."

**N. H., Somersworth**—SERVICE STATION—Roswell & Watson, c/o J. E. Richardson, archt., 56 Grove St., Dover, taking bids and open same about Aug. 21. 1 story, basement, irregular sized super service station, concrete found., High St. To exceed $28,500.

**N. Y., Brooklyn**—BULK OIL STORAGE PLANT—Arguls Gas & Oil Sales Co., 136 Flatbush Ave., taking bids bulk oil storage plant, Newtown Creek and Greenpoint Ave. $750,000. E. M. Waarff, c/o owner, engr.

**N. Y., Somers**—POWER PLANT—See "Contracts Awarded."

**Tex., Rockdale**—POULTRY KILLING PLANT—See "Contracts Awarded."

**CONTRACTS AWARDED**

**California**—ORE MILL—Big Wedge Gold Mining Co., 407 Trans-America Bldg., Los Angeles, developing mining property, incl. mine structures and mill, Inyo Co., day labor. To exceed $150,000. Noted Aug. 2.

**Calif., Montalvo** — PACKING PLANT — Saticoy Lemon Assn., A. J. Thille, pres., general contract rein.-con. packing plant, 1¼ mi. east of here, Ventura Co., to Rainey & Macisaac, 2100 East 25th St., Los Angeles, $42,987. Noted Aug. 2, under "Ventura."

**Calif., San Francisco**—WAREHOUSE—L. A. Myers, 3 story, concrete, 9th St. near Howard St., to Jacks & Irvine, 74 Montgomery St., $40,250. Awarded Aug. 6.

**Calif., Torrance** — CHEMICAL PLANT — Hughes-Mitchell Processes, Inc., Denver, Colo., L. M. Hughes, chn. Bd. Directors, Majestic Bldg., Denver, Colo., chemical plant for treatment of lead-zinc products therefrom, 190th and Normandie Sts., to Austin Co. of California, 777 East Washington St., Los Angeles; steel bins, to Consolidated Steel Co., 6500 East Slauson St., Los Angeles. Est. exceeds $250,000. Noted July 12.

**Mass., New Bedford**—CASTING SHOP—Revere Copper & Brass, Inc., 24 North Front St., general contract 1 story, 167x190 ft., brick, steel, concrete, North Front St., to J. W. Bishop Co., 182 Sycamore St.***plumbing, to Geo. J. Allen & Co., 422 Acushnet Ave.***plumbing, to be done by owner. Noted Aug. 2.

**Mass., Woburn**—GLUE FACTORY—Austin Co., general contractors, 19 Rector St., New York, plumbing for 1 and 2 story, basement, 142x588 ft., glue manufacturing plant, Merrimac St., to J. B. Farnsworth, 153 Tyler St., Boston, for New England Chemical Industries, Inc., 500 5th Ave., New York. Noted June 13.

**Mich., Detroit**—PLANT—Linde Air Products Co., 7501 St. Aubin Ave., plant addition, to Austin Co., 16112 Euclid Ave., Cleveland, O. Est. $35,000 or more.

**Minn., Minneapolis**—GRAIN ELEVATOR—John Kellogg Co., W. G. Kellogg, mgr., 369 New Chamber of Commerce Bldg., grain elevator addition, incl. eight 500,000 bu. grain tanks, 12th Ave. S.E. and Great Northern Ry. tracks, day labor. Est. $75,000.

**N. Y., Elmira**—WAREHOUSE, etc.—Standard Oil Co. of New York, warehouse, garage, office, bulk station, to F. H. Parks, 521 Liberty St., Buffalo. Est. $50,000. Noted July 5.

**N. Y., Jamaica**—STORAGE, etc.—Jamaica Buses, Inc., 107-16 New York Ave., storage, bus terminal, repairs, etc., New York and 114th Aves., to C. T. Wills, 286 5th Ave., New York. Est. $55,000 or more. Noted Aug. 2.

**N. Y., Rome**—PLANT—Rome Mfg. Co., subsidiary Revere Copper & Brass Co., 230 Park Ave., New York, plant addition, to Zingerline Bros., Rome. Est. exceeds $35,000.

**N. Y., Somers**—POWER PLANT—New York State Electric & Gas Corp., Ithaca, electric power plant, here, separate contracts and day labor. To exceed $28,500. Public Service Comn. authorized project.

**N. Y., Suffern**—PERFUME FACTORY—Allied Products Co., Suffern, perfume factory addition, to Barney Ahlers Constr. Co., 110 West 40th St., New York. Est. $150,000.

**N. C., Greensboro** — MANUFACTURING — Proximity Mfg. Co. electrical contract for textile plant addition, to Bryant Electric Co., High Point, $40,000. Noted Mar. 15, under "Contracts Awarded."

**O., Cleveland**—DISTILLERY—Clifton Distillery Co., W. N. Israel, genl. mgr., 2500 West 25th St., general contract altering 3 story, basement, 75x127 ft., distillery, incl. motors, copper, wood, steel and glass tanks, condenser, monorail hoist, 2500 West 25th St., to M. Lees, 2816 Mayfield Rd. Est. $50,000. Awarded Aug. 13.

**O., Cleveland**—PRESS ROOM—Fisher Body Co. of Ohio, H. E. Beyster, engr. of constr., General Motors Bldg., Detroit, Mich., steel for 1 story, 139x290 ft., brick, steel, concrete press room addition, East 140th St. and Coit Rd., to Jones & Laughlin Steel Corp., Pittsburgh, Pa. Total est. $200,000. Noted Aug. 9 Daily.

**Pa., Phila.**—PLANT—Swift & Co., Chicago, Ill. and Phila., plant addition, to Irvin & Leighton, 1505 Race St. Est. $40,000. Noted July 12.

**Wis., Milwaukee**—FACTORY — Jno. Hansen Soap Co., 3000 West Hampton Ave., 2 story, basement, 50x87 ft. soap factory addition, Hampton St., to Dick Wiersma, North Ave. and Club Pl. Awarded Aug. 6. Contractor sublet millwork, to Grabben Mfg. Co., 1136 West National Ave.***ready mixed concrete, to Lews Lime & Cement Co., 1136 East North Ave.*** steel sash, to Biersach & Niedemeyer, 1937 North Hubbard Ave.***painting, to J. Pellegrini, 4328 North Morris Blvd.***hardware, to C. F. Hilgendorf, 1033 North 3rd St.

**Ont., Toronto**—WAREHOUSE and GARAGE—J. A. Parrett, archt., c/o Loblaw Groceterias Co. Ltd. (owner), Bathurst and Fleet Sts., general contract 1 story, basement, 160x160 ft., rein.-con. addition to warehouse, 2 story, 100x300 ft., rein.-con., steel garage, Fleet St., to Richardsen Constr. Co. Ltd., 10 Adelaide St. E., about $190,000. Noted June 7.

†*Federal Government.*

***For official proposal advertising see Searchlight Section***

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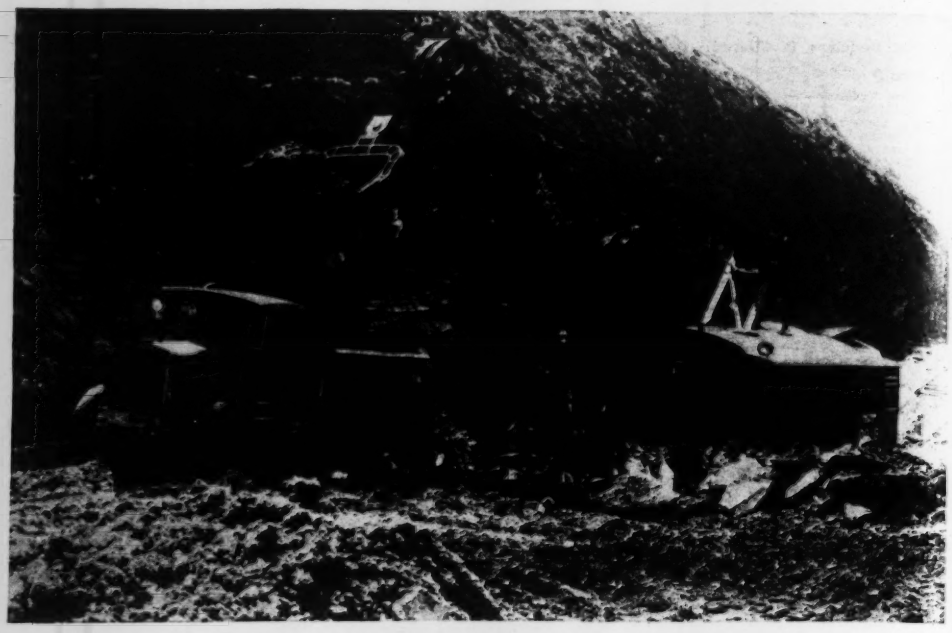

LINN'S huge payload capacity and flexible traction keep costs low for the Plymouth Excavating Co., Plymouth, Pa.

LINN TRACTORS

LINN Products are patented

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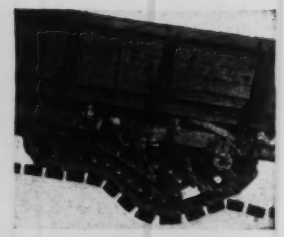
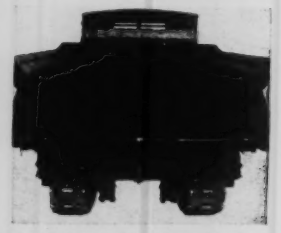


LINN patented flexible traction unit assures full gripping surface at all times.



LINN'S wide tracks make excellent compacting unit. It backs right to the edge of the dump . . . eliminating bulldozing.

Contractors have found that the sure way to keep yardage moving—and keep costs low—is to use a haulage unit that can work and earn every day. Here we have the answer for the increasing popularity of the LINN.

In rain or snow . . . through muck and mire . . . over rocks, stumps and roughest terrain . . . up grades impassable with any other type of unit, the LINN pulls through with capacity payloads without any delay. Weather or floor conditions mean nothing to LINN.

And the high speed and maneuverability of the LINN save time on every job. It has the same speeds either reverse or forward. In tight quarters, no time need be lost in turning, for reverse seat and controls are provided for high-speed reverse driving. Furnished either gas or Diesel powered.

Other exclusive LINN features make this the ideal haulage unit for your requirements. The LINN booklet describes all. Send for your copy today.

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